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THE MALE GENITAL ARMATURE IN THE ORDER ANOPLURA, OR SUCKING LICE.

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Only in very recent years has the value of the male genital armature in taxonomic work on the Anoplura been appreciated. In 1907 Pawlowsky made studies of the genital structures of the males by sectioning specimens. But it was not until 1910 that there was any extended comparative account given. In that year Mjöberg published his very extensive studies in which he figured and described many of the chief features of the hard parts for several species of sucking lice. He was the first to employ some of the terms largely used today for the more conspicuous parts, such as the basal plate, parameres and the preputial sack.

Cummings (1916) very accurately figured and described the hard parts of the male genitalia of various *Linognathus* species and worked out what he considered to be homologies with the genital parts as found in the males of biting lice. He gave an accurate account of the finer inner chitinous structures and in naming these introduced such terms as endomere, telomere and hypomere.

Nuttall (1916) was the first to work out the complete gross morphology and the functions of the genital parts for a single sucking louse species. This he did for one of the sucking lice of man, *Pediculus humanus* Linnaeus. Nuttall made dissections of the parts in order to show muscle attachments and the relationships of the soft tissues, and he studied the process of copulation in living specimens.

Ferris in his more recent taxonomic papers has drawn the hard genital parts for the males of many species, using Mjöberg's terminology for the basal plate and parameres.

Notwithstanding the various valuable contributions of these workers we find that for many species of sucking lice the structure and relationships of the finer parts of the genitalia have not been described or figured, and the homologies of these parts have not been ascertained.

In the following account of the male genital armature of the sucking lice an attempt is made to present a logical exposition of the structure and function of the parts as they are known in certain characteristic species, to make a start in homologizing the parts, and to synonymize the technical names as applied. A particular effort has been made to homologize the types found in the Pediculidae with those of other families.

GENERAL PLAN OF THE MALE COPULATORY APPARATUS.

The male genital armature (Fig. 1) and most of the genital apparatus of sucking lice lie in and are developed from an inpocketing of the posterior wall (genital cavity) of what is usually called the last abdominal segment. The hard parts—rods, plates and tube-like structures—are developed almost entirely from a continuation of this wall in the form of an eversible sac, the internal sac, which at its inner end is continuous with the ductus ejaculatorius. At this junction of the internal sac with the end of the ductus ejaculatorius, in most species a penis has been developed which is supported by one or more sclerotized rods or strips. From the floor of the internal sac and also from the floor of the genital cavity there is developed a sclerotization known as the basal plate, which is usually a large conspicuous structure. It serves as a base for the movement and attachment of many of the other parts. At its distal end it bears a pair of hinged, forceps-like appendages, the parameres.

In some species there are no other sclerotized parts, yet in most species sclerotizations of parts of the internal sac are observed. These are present in various forms and have been called by Cummings and others endomeres. It is in regard to the position, structure and relationships of these endomeres and their various parts that we are in need of most information to-day. The endomeres doubtless frequently function to give rigidity to the internal sac when the latter is protruded. They evidently at times serve for the muscle attachment of retractor muscles of the sac; again the distal endomeres frequently engage

the parameres and help the latter structures to function more properly. The proximal, or anterior, endomeres may articulate with the parameres or the rods of basal plate, or they may engage the penis near or at its base. It is suggested in this paper that the endomeres be named according to their fundamental positions in relation to the internal sac as: anterodorsal, posterodorsal, or ventral (Fig. 1). If the anterodorsal and posterodorsal are united the term dorsal or holodorsal may be applied. Where the ventral endomeres shift their position so

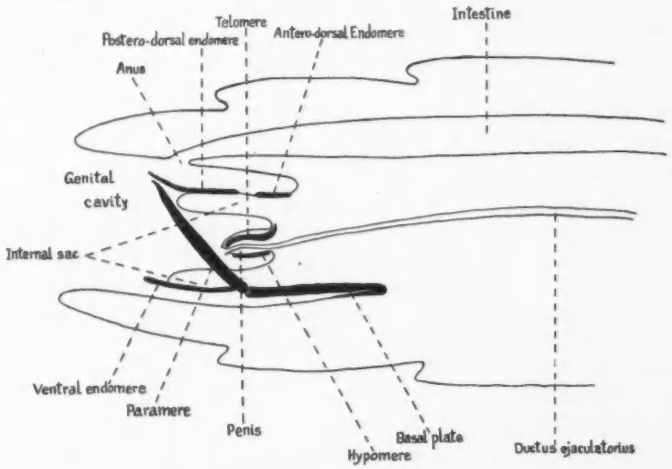


FIG. 1. Paramedian section of last three segments of abdomen of a male sucking louse, illustrating parts of genitalia and their relationships. (Diagrammatic).

that they lie between the parameres, they may be called the posterior endomeres, unless posterodorsal ones are present. The ventral, or posterior, endomere in some species hinges on the parameres.

These different structures of the male genitalia of sucking lice have their counterparts in similar structures in the genitalia of biting lice (Fig. 2), as has well been demonstrated by Cummings. If, indeed, the two groups of lice have had a common origin homologous structures should exist in the male genital armatures of both. It is more probable, however, that the biting and sucking lice had independent origins, but both from psocid-like ancestors.

COMPARATIVE MORPHOLOGY AND COMPONENT PARTS.

The genital cavity (Fig. 1) is usually almost or quite filled by the male genitalia. At the top of this cavity is an opening, the anus.

The *basal plate* (Fig. 1) is more commonly a plate-like structure with its lateral margins thickened into rods (Figs. 3, 6, 7 and 9). In some species only the rods are present, and in others there are no lateral marginal thickenings (Fig. 4).

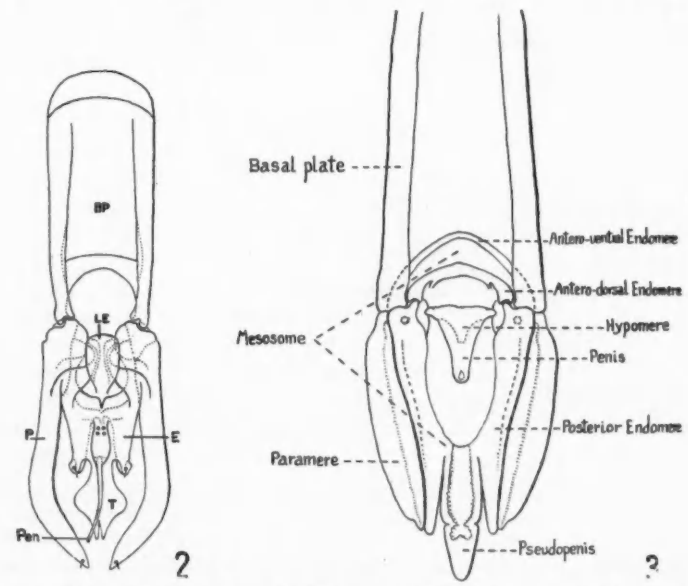


FIG. 2. The genital armature of a biting louse (*Philopterus acanthus* (Giebel)); *B P*, basal plate; *L E*, lower endomere; *P*, paramere; *E*, endomere; *Pen.*, penis; *T*, telomere. (Figure and terminology after Cummings.)

FIG. 3. Dorsal view of male genital armature of *Phthirpediculus propitheci* Ewing.

As shown by Cummings (1916) the basal plate, in some of the biting lice at least, is formed from both the floor of the genital cavity and that of the internal sac (Fig. 1). The basal plate is probably the same structure as the phalliger of Crampton (1918) found in certain of the more generalized groups of insects.

The basal plate carries above it the internal sac and its parts, when the latter are withdrawn into the body. It has

hinged to its distal end, probably in all species, the parameres (Figs. 1, 2, etc.). In addition, the ventral or posterior endomere may hinge to the end of the basal plate, as in *Phthirpediculus propitheci* Ewing (Fig. 3).

Nuttall (1916) has shown that in *Pediculus humanus* Linnaeus the upper anterior portion of the basal plate serves as a place of origin for numerous muscle fibers that retract the internal sac. I have demonstrated by dissection the presence of these muscle fibers in *Haematopinus tuberculatus* (Burmeister) (Fig. 6), in which species the floor of the sac is sclerotized, a large ventral endomere being present. In this case the muscles may serve to flex the ventral endomere rather than to retract the sac.

The *parameres* (Figs. 1, 3, etc.) are hinged to the lateral distal portion of the basal plate at the ends of the rods. They may be free and clasper-like, or may be united with the ventral endomere for their entire length.

In the Pediculidae the parameres articulate on their inner side with the well developed endomeres and in the genus *Pediculus* are evidently greatly reduced, serving only as small sclerotized pieces between the large endomeres and the basal plate (Fig. 9, *Dil.* l. sp.).

The *internal sac* (Fig. 1), called by Mjöberg the "preputial sack," by Cummings the "mesosome" and by Nuttall the "vesica penis" (Fig. 9, *V. pen.*), is probably a structure homologous in relationship and function with the internal sac of beetles. The eupenis, or praeputium, of Crampton (1918) is probably the same structure, which is found in many of the more generalized insects. The fundamental relationships of the internal sac have already been stated. It should be added that in many species the inner surface of the sac when withdrawn is studded with minute prickles (Fig. 9). These prickles point backward when the sac is withdrawn in the body, but when it is protruded, as in copulation, they then lie on the outside of the sac and point in the reverse direction. Doubtless they serve to engage the wall of the vagina when the sac is dilated and hold the penis in its inserted position until the semen has been discharged through the ductus ejaculatorius.

The *penis* is a protuberance or tube at the opening of the ductus ejaculatorius. Its base is continuous with the wall of the sac at the latter's apex. Usually one or more rods or strips

are present in the wall of the penis. In some species, as in *Pedicinus rhesi* Fahrenholz, the penis is a long sclerotized tube (Fig. 8). In *Pediculus* species the penis is joined at its base to a sclerotized rod called by Nuttall the *statumen penis* (Fig. 9, *St. pen.*). Some species appear to be without a penis, and in several species it is a minute structure.

The *telomeres* (Fig. 1) are chitinous rods or strips on the sides of the penis. They are probably more commonly united so as to form a tube.

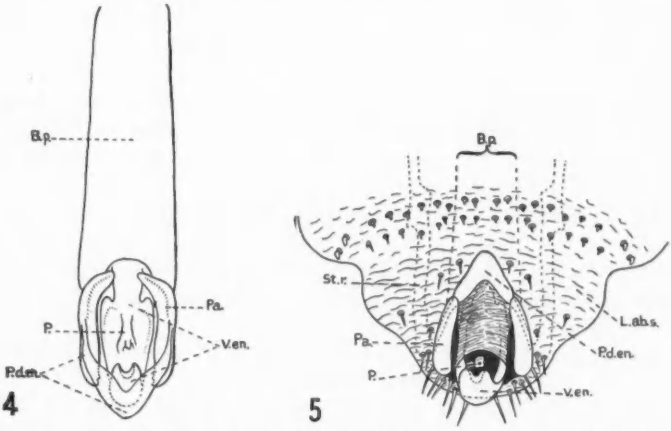


FIG. 4. Genital armature of male of *Echinophthirius phocae* (Lucas), from above, in retracted position. *B. p.*, basal plate; *P.*, penis; *Pa.*, paramere; *P. d. en.*, posterodorsal endomere; *V. en.*, ventral endomere.

FIG. 5. Tip of abdomen of male of *Echinophthirius phocae*, from above, showing the genitalia partly protruded. *B. p.*, basal plate; *L. ab. s.*, last abdominal segment; *P.*, penis; *Pa.*, paramere; *P. d. en.*, posterodorsal endomere; *st. r.*, sternal rod; *V. en.*, ventral endomere.

The *hypomere* (Fig. 1) is a small sclerotized strip on the ventral surface of the penis. In *Phthirpediculus propitheci* Ewing (Fig. 3) it is well developed. In most species this structure is either lacking or united with the telomeres to form the tube and base of the penis.

The *ventral endomeres* (Figs. 1, 4 and 5) represent the sclerotization of the lower part of the internal sac distal to the ventral plate. They are usually united, forming a structure most diverse in form and evidently of a varying function. From the standpoint of the distinction of species this structure

is, in the opinion of the writer, the most important of all, but unfortunately it is scarcely mentioned in any of the existing descriptions of sucking lice; and, with possibly a few exceptions, it has not been carefully drawn or studied. Sometimes this structure is divided, being represented by a pair of ventrolateral rods, but in nearly all instances it is a single, more or less U-shaped or V-shaped structure (Fig. 5, *V. en.*), which usually lies below the parameres and is entirely free from the latter.

In the more specialized species, in the ungulate and primate infesting lice, the ventral endomere engages or is articulated to the parameres; in which cases it is found that frequently they come to lie inside instead of below the parameres as they do in *Phthirpediculus propitheci* Ewing. In *Pediculus humanus* Linnaeus this endomere becomes terminal (Fig. 9, *Dil.*) and is used, as Nuttall has observed, to dilate the vagina of the female before the insertion of the sac and penis.

The *anterodorsal endomere* (Figs. 1 and 3) usually is a sclerotic band that lies near the base of the internal sac above. It is lacking in many species and in some apparently is fused with other sclerotized structures. In *Phthirpediculus propitheci* Ewing (Fig. 3) it is arch-like and is hinged to the bases of the posterior endomere.

The *posterodorsal endomere* (Figs. 1, 4 and 5, *P. d. en.*), frequently absent, is a well developed structure in *Echinophthirius phocae* (Lucas) (Figs. 4 and 5, *P. d. en.*) where it is remarkably similar in structure to, and probably has the same function as, the posterior endomere in *Pediculus humanus* Linnaeus.

Mjöberg (1910) has probably noticed and described this structure, but if so he does not give its proper relationship. More probably his "extra chitinous support" included both the posterodorsal and the ventral endomeres which in specimens with protruding genitalia are seen to be quite different (Fig. 5).

In *Echinophthirius phocae* (Lucas) the posterodorsal endomere (Figs. 4 and 5, *P. d. en.*) is a conspicuous arched chitinous structure which engages the parameres dorsally. When the genitalia are withdrawn into the body, this sclerite extends backward beyond both the parameres and the ventral endomere, in fact, the ventral endomere ends in a broad curved hook which lies inside the bend of the posterodorsal endomere.

THE GENITAL ARMATURE IN THE GENUS HAEMATOPINUS LEACH.

The genital apparatus of the type species of *Haematopinus, H. suis* (Linnaeus), has been well figured and described by Mjöberg (1910) and by Miss Florence (1921). It is of a very simple, and doubtless degenerate type. The parameres are short stubs, and the internal sac is without endomeres. Except

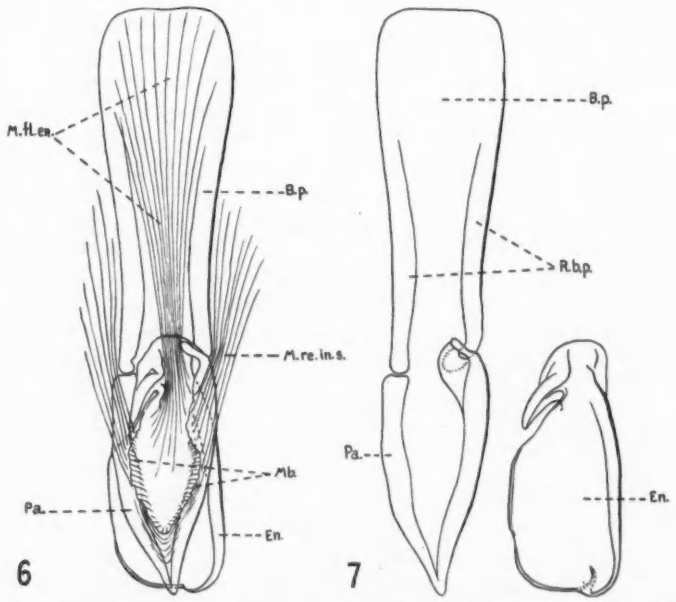


FIG. 6. Dorsal view of male genital armature of *Haematopinus tuberculatus* with most of vesica penis and ductus ejaculatorius removed to show muscle attachments. *B. p.*, basal plate; *En.*, endomere; *Mb.*, membrane; *M. fl. en.*, muscle for flexing endomere; *M. re. in. s.*, rectractor muscle *in situ; P. a.*, parameres.

FIG. 7. Same as Figure 6 except all soft tissue has been removed and hard parts disarticulated. *R. b. p.*, rods of basal plate.

for the basal plate, the penis is the only well developed sclerotized structure in the whole genital apparatus.

Being familiar with the structures in *Haematopinus suis* (Linnaeus), the writer was much surprised upon dissecting the male genital armature of *Haematopinus tuberculatus* (Bur-

meister) to find a type (Figs. 6 and 7) entirely different and remarkable in that all sclerotized parts are asymmetrical.

In *Haematopinus tuberculatus* (Burmeister) the parameres (Figs. 6 and 7, *Pa.*) are very large and conspicuous. They unite at their tips so as to form a single V-shaped structure. The right paramere is longer than the left and is expanded and perforated at its base where it articulates with a projecting knob of the right rod of the basal plate (Fig. 7). Below the parameres there is a very large, asymmetrical endomere, which is shaped much like a scoop (Fig. 7, *En.*). It has a strong carina on its right margin and a large, backwardly pointed hook on the left side near the base.

By dissection it was easy to demonstrate the attachments of the two chief sets of muscles. One of these sets (Fig. 6, *m. fl. en.*) arises from the upper side of the basal plate along about the first one-third of its length and is inserted chiefly, if not entirely, into the upper surface of the large, flat endomere. Its function appears to be the flexing of the endomere. These muscles are the same as Nuttall's retractor muscles of the vesica penis in *Pediculus humanus* Linnaeus. In this species, which lacks the ventral endomere, the muscles are inserted, according to Nuttall, into the wall of the vesica itself. The action of these muscles, Nuttall states, is to return the vesica to its resting position. A similar action may be effected in the case of *Haematopinus tuberculatus* (Burmeister) during certain stages of the process of retraction of the vesica. The chief action of this muscle would seem, however, to be the flexing of the ventral endomere itself.

Very powerful muscles (Fig. 6, *M. re. in. s.*) arise on either side of the ventral plate from the conspicuous abdominal sternal plate of this species and attach chiefly to the wall of the internal sac. They probably not only retract the internal sac but the whole copulatory apparatus, as their origin from the sternal plate would seem to indicate. They may be concerned in flexing the parameres during the later stage of the protrusion of the genitalia.

The male apparatus of *Haematopinus eurysternus* (Nitzsch) was examined. It is of the same type and arrangement as in *Haematopinus tuberculatus* (Burmeister), but differs in having a rather well developed penis, and in having the parameres and endomere of a different shape.

The presence of large, well developed and apparently functional parameres in these two bovine-inhabiting species, as well as a large endomere, is of much significance as such conditions are not found in the swine-infesting species, *H. suis*.

THE HOMOLOGY OF PARTS OF THE MALE GENITAL ARMATURE OF PEDICULUS HUMANUS LINNAEUS.

Nuttall (1916) in his excellent paper on "The Copulatory Apparatus and the Process of Copulation in *Pediculus humanus*," gives a detailed account of the male genital armature in this man-infesting louse. One question which he did not definitely settle was the homology of three of the sclerotized parts. These three he called the dilator (Fig. 9, *Dil.*), the lateral spur of dilator (Fig. 9, *Dil. l. sp.*) and the statumen penis (Fig. 9, *St. pen.*).

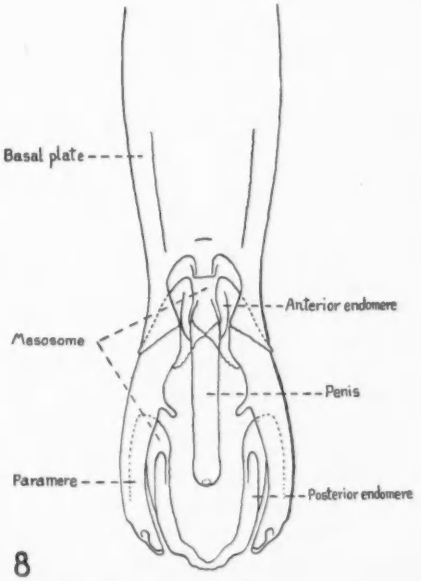
Speaking of the first two of these structures Nuttall states (p. 299): "Adopting for the moment the nomenclature of Cummings, I believe that in *Pediculus* we have a partial fusion of the endomeres distally and that they exceed the parameres in length, the latter being fused laterally to the endomeres and thus appearing merely as two small points."

Soon after the present writer discovered the new genus *Phthirpediculus* and its single species, *propitheci*, on the skins of a lemur, *Propithecus edwardsi*, it occurred to him that in this species, which represented a genus more generalized than, but clearly related to, *Pediculus*, the genital armature would possibly give a clue to homologizing the parts of the armature in *Pediculus humanus* Linnaeus. Hence the armature was studied and drawn (Fig. 3).

When the parameres and posterior endomeres of *Phthirpediculus propitheci* Ewing were examined it was noted that both these structures were hinged to the rods of the basal plate. This unusual condition was further matched by another—the parameres engaged the endomeres for their entire length. However, when the type of armature found in *Phthirpediculus* was compared with such primitive and generalized types as are found in rodent-infesting species, it was observed that the types are very similar except for the two unusual conditions just noted.

Thus far it appeared that, not only had no light been thrown upon the possibility of homologizing the parts in *Pediculus*

humanus Linnaeus, but an attempt to do so, using alone the armature of *Phthirpediculus* as a basis, would be positively misleading. In the monkey-infesting genus *Pedicinus*, however, it was observed that in *Pedicinus rhesi* Fahrenholz the key to the solution had been found. In this species the genital armature of the male (Fig. 8) gives an excellent intergrade between that of *Phthirpediculus* and *Pediculus*.



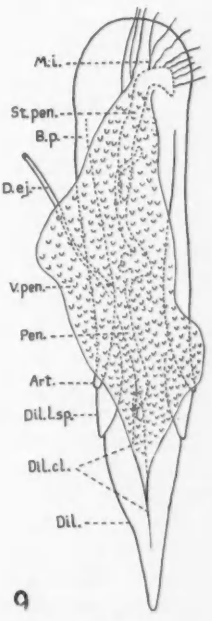


FIG. 8. Dorsal view of genital armature of male of *Pedicinus rhesi* Fahrenholz, *in situ*, with parts labeled.

FIG. 9. Dorsal view of male genital armature of *Pediculus humanus* Linnaeus. *Art.*, articulation; *B. p.*, basal plate; *Dil.*, dilator; *Dil. cl.*, cleft in dilator; *Dil. l. sp.*, lateral spur on dilator; *D. ej.*, ductus ejaculatorious; *M. i.*, muscular insertions in chitin; *Pen.*, penis; *St. pen.*, statumen penis; *V. pen.*, vesica penis. (Drawing and terminology after Nuttall.)

In *Pedicinus rhesi* Fahrenholz the parameres are large, with freely projecting arms, and doubtless perform their usual functions. The posterior endomere is well developed, of much the same shape as in *Pediculus humanus* Linnaeus, and firmly engages the parameres ventrally near their middle (Fig. 8).

An examination of the muscles show their attachments to be similar to those of *Pediculus humanus* Linnaeus. That the inner structures in *Pedicinus rhesi* Fahrenholz (Fig. 8) are the same as the dilator of *Pediculus humanus* Linnaeus there can be but little doubt, as this structure arises from, or rather engages, the parameres distal to their bases. That this structure in *Pedicinus rhesi* Fahrenholz should be regarded as the ventral endomere is shown by its position ventral to the parameres and its relation to the internal sac and its muscle attachment. The presence of the long, free arms of the lateral sclerites in *Pedicinus rhesi* Fahrenholz, together with their attachment to the ends of rods of basal plate as well as some other relationships, shows them to be the true parameres, parameres which bear the ventral endomeres, just as Nuttall's "lateral spurs of dilator" do; hence it is evident that these spurs are the real parameres as Nuttall suggested, and that his dilator is in reality the fused endomeres, or more specifically, the fused ventral endomeres.

The *statumen penis* (Fig. 9, *St. pen.*) of Nuttall likewise may be homologized by comparison with the genital armatures in *Phthirpediculus* and *Pedicinus*. The *statumen penis* (Fig. 9, *St. pen.*) is a long, irregular chitinous strip which supports the penis. In *Pedicinus* there is a much larger piece which is articulated with the parameres at the latter's bases. This structure (Fig. 8) is an anterior endomere. Turning to *Phthirpediculus* we find that there is both a dorsal and a ventral anterior endomere, each of which articulates with the enlarged bases of the parameres (Fig. 3). The anterior endomere of *Pedicinus*, therefore, appears to represent the fused anterodorsal and anteroventral endomeres. From this fused structure in *Pedicinus* probably was developed the *statumen penis* of *Pediculus*.

A large series of *Pediculus* forms from American monkeys of the genus *Ateles* was examined to see if in any there was to be found a different type of genital armature from that of *Pediculus humanus* Linnaeus. In no instance was any significant difference noted. This appears no less than remarkable when we consider that all of these monkey-infesting species had pleural plates quite different from those of *Pediculus humanus* Linnaeus.

SUMMARY.

1. The work of Cummings and Nuttall has been taken as a basis for the extension of our knowledge in regard to the types of the male genital armature in the Anoplura.

2. In the main the terminology of Cummings has been adopted, but some new terms are introduced.

3. A rather remarkable asymmetrical type of genital armature is studied and described for the first time.

4. By studying types of lice from rodents, lemurs, and monkeys the parts of the male genital armature of the human louse, *Pediculus humanus* Linnaeus, have been homologized.

5. In the male genital armature of *Pediculus* species the "lateral spurs of dilator" of Nuttall become the parameres, the "dilator" becomes the fused ventral endomeres, and the "statumen penis" becomes the anterior endomere.

6. The genital armature of American monkey-infesting species of *Pediculus* not only is of the same type as is found in the man-infesting forms, but it does not vary sufficiently to be of value in specific differentiation.

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THE BIOLOGY OF ENCYRTUS INFIDUS ROSSI, A PARASITE OF LECANIUM KUNOENSIS KUW. (HYMEN.).

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Lecanium kunoensis Kuw.[1] is the most common and injurious of the lecaniine Coccidae attacking cherry in Chosen (Korea). This scale is exceedingly heavily attacked by the internal parasite *Encyrtus infidus* Rossi.[2] The host passes through a single generation each year, and oviposition takes place very largely during late May and early June. The parasite, on the contrary, completes at least two full generations to each one of the host. The first of these passes the winter in the young scales and emerges early in the spring. The adults of this generation attack the half-grown or newly transformed adult females and the second brood emerges from them later in the spring.

In 1923 and 1924 the author had the opportunity of studying the biology of this species, and the conclusions arrived at were again verified in 1928. The interrelationships which were revealed between the parasite and the host are quite complex and the adaptations of the parasite, particularly as regards the manner of respiration of the late larval and pupal stages, are worthy of particular attention.

These studies upon the biology of *Encyrtus infidus* were made exclusively upon the second, or spring, generation, but no opportunity was afforded to make similar studies upon the first generation during the autumn months.

LIFE HISTORY.

Oviposition.—In depositing the egg in the half-grown host scale the female Encyrtus usually inserts the ovipositor by a backward thrust into the lateral region of the body. In the case of the more advanced host individuals she may stand upon

[1]Determined by Dr. H. Morrison.
[2]Determined by Mr. A. B. Gahan.

the dorsum and insert the ovipositor perpendicularly. The egg is laid internally in the body of the host and is attached to the integument by the stalk. The collapsed distal portion of this stalk remains extruded through the aperture made by the ovipositor. The main body of the egg measures 0.32 mm. in length, while the stalk is 0.3 mm. long.

The First Larval Stage.—The primary larva of *Encyrtus infidus* is identical in form with that of many other Encyrtidae of similar habit. The tracheal system consists of the two longitudinal trunks, with the usual anterior commissure and posterior commissure, and a single pair of spiracles borne on the last segment of the abdomen. The caudal end of the body is closely enveloped by the eggshell, and this close connection persists throughout the succeeding stage. The egg stalk serves as a channel through which air is secured by the young larva, this being drawn in by a muscular contraction of the caudal segments.

The Second Larval Stage.—This is identical with the preceding stage in all essential respects, and the posterior segments are encased by the cast larval skin as well as by the eggshell.

The Third Larval Stage.—In this stage there is revealed the first noticeable departure from the normal habit of this group of parasites. The tracheal system bears three pairs of spiracles, which are situated at the foremargin of the third thoracic segment and on the seventh and ninth abdominal segments, respectively. The last pair is not situated directly on the surface of the body, as is normally the case, but instead, the spiracular stalks extend caudad for a distance equal to one-half to two-thirds of the body length, and the spiracles are situated at the ends of these stalks. These spiracles maintain the same relative position in relation to the eggshell and to the preceding cast skins as did those of the younger larvae.

This extension of the caudal spiracular trunks can hardly have any direct significance in so far as respiration is concerned, but the utility of the modification may be explained in another way. In comparison with the body of the developing parasite, that of the host is of great size, and the larva, due to its connection with the egg stalk, is unable to move about freely for purposes of feeding. The development of these long spiracular stalks greatly extends the feeding range of the larva, and permits of a greater dispersion in the host body

in those cases where a number of larvae originate from a cluster of eggs deposited at one point in the body wall. This greater distribution, resulting in reduced feeding at any one particular point, would tend to prolong the life of the host, a result generally considered to be favorable to parasite development. The fact that parasitized individuals are alive and continue to oviposit until the emergence of the parasite adults indicates that this result is attained to an exceptional degree.

The Fourth Larval Stage.—In the fourth stage of development the larva is of normal form, with the exception that the tracheal system now bears only two pairs of spiracles. These are situated on the third thoracic and the eighth abdominal segments, respectively. The cast skin of the preceding stage is not cast off completely, but instead forms a shield over the dorsum (Figs. D and E), and adheres closely to the body. In contrast to the preceding cast skins, which remain unchanged after the molt and reveal no effort on the part of the host to encapsulate them, this skin becomes much darkened and indurated. While this is believed to be due to a host reaction yet the explanation thereof is not clearly understood. The darkened shield is of quite constant outline, extending very nearly the full length of the dorsum of the young fourth-stage larva, and may cover a portion of the midlateral region. The spiracular areas of the larva are never covered.

The two heavy spiracular stalks of the cast skin retain their connection with the exuvium, and the tracheal trunks usually lie beneath the shield and at one side. The spiracular stalks do not serve the succeeding larval stage, however, and consequently some other provision is essential to secure the necessary oxygen supply. It is in the accomplishment of this purpose that *Encyrtus infidus* reveals a most striking adaptation in habit.

The fourth stage here described is considered to be the last of the larval forms, though this was not established with certainty, and an additional one may intervene. It is presumably the last stage which effects a reversal in position, after which the body lies with the head at the base of the spiracular stalks of the third-stage exuvium, and partially enveloped by it. This change in position occurs towards the end of the stage, and marks the cessation of feeding.

The union with the tracheal system of the host, which takes place during this stage, is brought about by a fusion between the spiracular areas of the parasite larva and the host tracheal branches. It is particularly noteworthy that this fusion is not directly with the spiracle of the parasite, but only with the integument in its immediate vicinity. Usually several tracheae are found to have made this connection at each of the four spiracles, and any or all of them may have more than one point of union. An examination of a typical fusion point reveals that the integument of the parasite larva is slightly raised at this point, forming a short, trough-like depression, in which the trachea lies. The integument is much darkened at this point, thus making the points of union readily distinguishable.

The union between the trachea and the larval integument is quite strong and permanent, rather than of a temporary nature. It results, however, in the weakening of the trachea, and when the parasite larva or pupa is dissected from the body of the host it usually breaks at this point, and the distal portion usually retains its connection with the larval skin. As a result, the branching trachea, which remains attached to the parasite body, appears to be a direct outgrowth from a spiracular area, and to this is probably due the earlier belief that these branches were of parasite rather than of host origin.

That the tracheal ramifications which extend from the spiracular areas of the parasite larva into the body of the host are of host rather than of parasite origin was established beyond question. In several instances the tracheae were traced directly from the host spiracle to the point of fusion with the parasite and then onwards to the viscera of the host. Occasional individuals revealed tracheae which had fused at two successive spiracular areas, as is illustrated for one individual in Figure D. In several cases the same trachea was noted to have fused with the spiracular areas of two larvae lying close together. Where a large number of individuals are crowded into a single host the tracheae connecting with the spiracular areas are all usually from the same host spiracle. Beyond the points of fusion there seems to be a greater branching and development of the tracheae than is normally the case, this possibly having been induced by the increased demands made upon them.

The period in the development of the parasite larva at which the respiratory connection is made is not constant, though it

normally occurs during the fourth stage. Occasional instances have been noted, however, where the union was made by the third-stage larva, which still possesses functional caudal spiracles. It is possible that, in the few instances noted, the normal functioning of these spiracles had been interrupted in some way, and for that reason the premature connection with the host respiratory system was made necessary.

The means by which the parasite larva effects this fusion is exceedingly obscure. Inasmuch as the connection is not at the spiracle, but with the integument in its immediate vicinity, a channel must be formed through both the integument and the wall of the host trachea. The fact that the union is effected at four points renders it improbable that the breaks in the tracheae are a result of laceration by the larva itself.

The tendency to fusion in the fourth-stage larva is very strong, and is not restricted to that with the host tracheal system alone. Several instances have been noted in which the larva had effected union with the discarded third-stage spiracular stalks of other individuals. In these cases the respiratory requirements were fully met, and consequently no connection was made with the host tracheal system. In one instance fusion was effected with the intestine of the host, though here a connection had also been made with a host trachea at the opposite end of the body.

The reversal of position by the parasite larva is an unusual modification in habit which apparently has been developed to overcome certain physical handicaps encountered at the time the adult emerges from the host. Where pupation has taken place with the body oriented in the same way as in the early stages, the head of the emerging adult faces the center of the body of the host, and consequently it must make its way through a considerable portion of the host viscera before escaping. Also, other larvae or pupae may bar its way. In the reversed position, with the head at the base of the third-stage spiracular stalks, the distance from the body wall of the host is much reduced, and there is no interference between individuals.

An examination of 100 pupae revealed that 78 were in the reversed position. From this series, and on the basis of other observations as well, it was concluded that the reversal of position occurs quite uniformly in host scales containing a

relatively small number of parasites, and that the change of position does not take place where an excessive number are present. In the latter case the body contents of the host are quite largely consumed, and the consequent crowding may also present physical obstacles to the accomplishment of this change. The need for the change is also much reduced because of the greater consumption of the body contents.

The pupal stage.—The transformation from the final larval to the pupal stage takes place within the unbroken skin of that stage. This skin becomes somewhat distended and filled with air, and the pupa, which is of normal form, is consequently surrounded by air and has no need for special respiratory modifications. The prothoracic, metathoracic, and the sixth pair of abdominal spiracles are exceptionally well developed and are much larger than those remaining. The prothoracic and abdominal spiracles are situated almost directly beneath the areas of fusion on the larval skin, though they are not in contact or connection with them.

At each side of the abdomen of the pupa, near the posterior pair of abdominal spiracles and the posterior spiracular areas of the larval skin, there is found a cluster of five to eight yellowish pellets of oval outline. These comprise the meconial discharge voided by the propupa, and they are arranged symmetrically and constantly at the points mentioned. So far as is known, this unusual arrangement of the meconial discharge in the spiracular areas has no particular significance.

The last larval skin of *Encyrtus infidus* is in all essential respects a true puparium. It completely encloses and protects the pupa, bears the spiracles through which the air supply is drawn, and within it the final transformation takes place.

The adult.—In its efforts to emerge from the body of the host, which is still alive, the parasite adult must first effect a break in the "puparium" which surrounds it, then scrape or bite away a varying amount of host viscera and tissue, and finally cut a hole in the heavily chitinized integument of the Lecanium female sufficiently large to permit of the passage of its body. In consequence of this, when emergence is finally effected the wasp comes forth very largely covered with body fluids and fragments of tissue of the host. This, however, gives the parasite little difficulty, and the body is readily and quickly cleaned. The host dies immediately as a result of this gross mutilation.

THE SEX RATIO AND REPRODUCTIVE POTENTIAL.

In the generation attaining maturity in the fully developed host scales, and emerging during the first week in June, the sex ratio was found to be 1 : 1.1. This figure is based upon the rearing of 248 adults from scales collected in the field. The preponderence of males, even though slight, is quite unusual in the family. No exact count was made of the numbers of each sex in the overwintering generation, though the ratio is known to approximate that given above for the second generation.

Oviposition records for a series of 15 mated females gave a general average of 140 eggs during a period of nearly one month. The reproductive potential of the species therefore has an approximate value of 66. Each of the above females was dissected after natural death and was found to contain a varying number of fully developed eggs in the ovaries. This has been found to be the case with practically all of the parasitic Hymenoptera studied by the writer, with the exception of the Eucharidae, many of which deposit the full quota of eggs at one operation. It is probable that under field conditions relatively few of the parasite females normally exhaust their reproductive capacity, but instead, continue to form eggs in diminishing numbers until death.

Rearing experiments with unmated females resulted in the production of male progeny only.

THE LIFE CYCLE OF ENCYRTUS INFIDUS IN RELATION TO THAT OF ITS HOST.

In the localities in which this parasite was studied it was confined strictly to *Lecanium kunoensis* upon cherry. The host has a single generation each year, the winter being passed in the early larval stages, and maturity is attained about the first of May. Oviposition takes place during the latter part of that month and during the early part of June.

Encyrtus infidus passes the winter in its immature stages within the young host scales, and only a single one develops in each. No observations were possible upon the biology of this generation, and the studies were restricted to the spring generation from the middle of April onwards.

The first of the spring brood of adults appears in the field about April 15, and the maximum numbers are attained by the end of that month. In 1923 the last female was noted on

May 21, while in 1928 none could be found after May fifteenth, at which time practically all of the progeny were in the second larval stage.

The emergence of the second brood of adults was surprisingly uniform, and took place during the first week in June. In 1928, 82 per cent of a total of 700 adults, of which the emergence date was noted, appeared June 1–5, inclusive. At the time of appearance of this brood there still remained a small proportion of the host adults which have been somewhat retarded in their development and have not yet deposited their full quota of eggs. In these females Encyrtus produced a partial third generation, though in numbers very small as compared with the preceding one. The females of this brood, as well as most of those of the second, then await the development of the young scales and oviposit in them during the late summer and early autumn. It is thus seen that the parasite has two complete generations, and a partial third, each year to one of its host. Theoretically this would appear to be a very desirable condition, and one conducive to maximum effectiveness. There are, however, certain factors which largely offset this advantage and which reduce the species to a point of relative ineffectiveness.

In any parasite species an essential qualification for effectiveness is that the host shall be killed before it is able to reproduce itself. This is fulfilled by the overwintering generation of *Encyrtus infidus*, and the mortality effected is therefore of maximum value. The second generation, however, presents a vastly different picture. Field counts revealed that only 6 per cent of the host scales had been killed without oviposition, and it was estimated that, among all of the parasitized scales, the egg deposition approached 50 per cent of normal. This occurred in spite of the fact that each parasitized scale produced an average of 6.4 encyrtid adults. A further examination of parasitized scales revealed that the host females continued to deposit eggs even after the parasites had attained the pupal stage. Oviposition frequently continues up to the very day of emergence of the first parasite, at which time death is brought about by mechanical injury.

An examination of infested trees showed that the parasitization by the overwintering generation of Encyrtus in 1927–28 was approximately 20 per cent, while that of the first spring generation upon the adult scales was in the neighborhood of 90 per cent. The progeny of this brood of adults effected 100 per

cent parasitization of the retarded host females available in early June. With this high degree of parasitization the scale persists each year at a numerical level sufficiently high to necessitate mechanical control measures were the infestation in a commercial orchard.

From the point of view of biological control the main limiting factor in this species is the lack of correlation in time between the development of the second parasite generation and the period of oviposition of the host. Were this parasite able to bring the second generation to maturity two weeks earlier than is actually the case only an occasional host scale would be able to deposit eggs, and effective control would unquestionably result. As it is, however, the high numerical level of the parasite has relatively little significance in respect to the restriction of reproduction of the host.

SUPERPARASITISM AND MULTIPLE PARASITISM.

Under field conditions in Chosen the percentage of parasitization of *Lecanium kunoensis* by *Encyrtus infidus* is so high as to give rise to very extensive superparasitism. The overwintering generation of the parasite never matures more than a single individual in each half-grown host scale, the limited food supply being here the controlling factor. Owing to the small size of the scales at the time they are parasitized, and their numerical abundance as compared with the Encyrtus females, it is improbable that many receive more than a single egg.

In the case of the spring generation upon the adult female scales the average number produced by each (as based upon rearings from 80 isolated individuals) was 6.4 Encyrtid adults, with a maximum of 9. This may be taken to represent very nearly the maximum parasite capacity of *Lecanium kunoensis*, as dissections of representative series revealed a considerable number of dead Encyrtus larvae in various stages in nearly every instance. The more advanced individuals naturally have a great advantage in the struggle for existence, and when the number in a given host is in excess of that which can be brought to maturity upon the available food supply the younger larvae die from starvation. Instances were noted in which as many as 21 larvae, all in practically the same stage of development, were contained in a single scale, and the entire lot had a pronouncedly unhealthy appearance indicating undernutrition. It appears that, in this species, starvation rather than

cannibalism is responsible for the elimination of the surplus individuals.

While a single host individual contains food materials sufficient to bring six or more Encyrtus to maturity, yet the presence of the full complement of parasites is not at all essential to the completion of development where a smaller number is present. Where only a single egg has been laid in the scale this individual will develop and emerge, even though only a small portion of the body contents of the host has been consumed. In this respect Encyrtus differs from many other parasitic Hymenoptera which develop in numbers in the host individual. In many of these cases the presence of the full complement of parasite larvae, with the consequent complete consumption of the body contents of the host, is essential to the completion of development of any or all of them, and if the number is insufficient then none is able to attain maturity. Death results through an excess of food materials, which brings about suffocation due to adverse physical conditions for pupation. Encyrtus overcomes this handicap by pupating within its last larval skin, which is still surrounded by the body fluids of the living host, and emerges therefrom irrespective of the presence of other individuals or of the physical condition of the host.

Multiple parasitism was observed to be of frequent occurrence upon this host, the other parasites involved being two species of Encyrtidae of similar general habit, though lacking the respiratory modifications of *Encyrtus infidus*. In these two species such modification is unnecessary in view of the relatively delayed development, as the death and partial dessication of the host takes place prior to emergence of the adults. Among the three encyrtid species attacking this host there exists a pronounced interspecific tolerance, in which there is no apparent conflict between the larvae, and frequently a number of individuals of two species are reared from the same scale. Multiple parasitism in this case is reduced in significance to the level of superparasitism, with the restrictive factor being the quantity of food available rather than the physical aggressiveness of the larvae. Consequently there is no more conflict between the different species than exists between individuals of the same species, and for that reason no one of them becomes dominant through this relationship. In general, however, Encyrtus dominates as a result of a slightly earlier time of appearance and oviposition.

LITERATURE ON THE BIOLOGY OF THE GENUS ENCYRTUS AND RELATED FORMS.

Encyrtus infidus Rossi.

The immature forms.—Silvestri (1919) has presented an extensive account of *Encyrtus infidus* as a parasite of *Sphaerolecanium prunastri* Fonsc. in Italy. The interpretations which are given for certain of the modifications in form and habit are at variance in several respects with those presented herein for what has been determined as the same species in Chosen.

In the third larval stage the caudal spiracular processes are only one-eighth the length of the body, and no other spiracles are present. This form was not observed in the species in Chosen.

The fourth stage of the Italian form is quite similar to the third as described herein, though the posterior spiracular stalks are considerably shorter. As in the preceding stage, no other spiracles are present. The posterior end of the body is enveloped by the exuvia of the preceding stages, a condition quite distinct from that shown for the form upon *L. kunoensis*, where the length of the spiracular stalks is sufficiently great to separate widely the larva from the cast skins of the earlier stages (see Fig. C).

According to Silvestri this stalked form is the final larval stage. In the latter part of the stage the connection with the exuvia is lost and pupation takes place within the last larval skin. No mention is made of a reversal in position of the pupa or of any connection in any stage with the tracheal system of the host, though it is stated that the free larva is surrounded by numerous host tracheae. The darkened area over the dorsum of the fourth stage is said to consist of a secretion of the lateral tergal glands.

In view of the differences which have been noted in the form and habit of the various larval stages it appears probable that the species discussed by Silvestri in Italy is not identical with that studied by the author in Chosen.

Seasonal cycle.—In Italy the seasonal cycle of *E. infidus* as a parasite of *S. prunastri* is quite similar to that of the species upon *L. kunoensis* in Chosen. The adults of the overwintering generation emerge in late March from host females which have just attained the adult stage. The following generation is

upon those females which escaped parasitization previously, and emergence takes place early in May. As many as 23 may reach maturity in a single host. Of the mature host females which are attacked by this brood approximately two-thirds die without oviposition, and of those which do deposit eggs the maximum number is approximately two hundred. The parasite is thus much more effective against *S. prunastri* in Italy, in so far as the prevention of host oviposition is concerned, than upon *L. kunoensis* in Chosen.

There is presumed to be a third generation upon an unknown alternate host, a conclusion based upon the absence of parasite eggs or young larvae in the young scales during June to November, inclusive. In Chosen *E. infidus* of the first stage were found in a number of young scales during October.

Encyrtus infelix Embleton.

The first studies upon the biology of the genus Encyrtus which revealed a clue to the unusual respiratory modifications of the early stages were those by Miss Embleton (1904) upon *E. infelix* as a parasite of *Saissetia hemisphaerica* Targ. in England. The interpretation then given of several of the modifications in form and habit, particularly those relating to respiration, are now known to be erroneous.

The egg is stated to be deposited invariably on the right side of the anal opening, though no explanation is given for this unusual constancy in position. What is termed the first observed larval stage possesses the two elongate caudal processes identical with those of the third stage of *E. infidus*. The tracheal system is described, and it is stated that no spiracles could be detected. "Possibly the tail-apparatus takes the place of stigmata, for it is a most remarkable arrangement, and suggests a parallel with the metapneustic tracheal systems of some Dipterous larvae in which there exist only a terminal pair of spiracles." This is quite certainly the case in view of the fact that the tracheal trunks are stated to extend into the caudal processes. This first observed stage is in all probability the actual third, and this conclusion is borne out by its relatively large size (0.75 mm.) as compared with that of the egg body (0.25 mm.).

In the second observed stage the tracheal system has two pairs of spiracles, which are situated on the third thoracic and

the seventh abdominal segments, while "behind the posterior commissure the trunks are continued, finally projecting out of the body as withered atrophied remains of the tail apparatus." This form corresponds to the fourth stage of *E. infidus*, in which the spiracular stalks of the third stage remain attached to the derm of the succeeding stage.

The third described stage is in reality the beginning of the prepupal form. It possesses two pairs of spiracles and "from each of these four spiracles there is a double tracheal tube running out into the host's body; these two branches become subdivided and ramify in the host tissue, and by this means, it seems, the parasite obtains its air-supply." Some doubt is expressed as to whether these structures are of host or parasite origin. The reversal in position of the pupa is noted. Certain "red oval plates" are found at the bases of the forked tracheal tubes near the posterior end of the body and, largely because of their position, are assumed to have some respiratory function. These occur in the same position in *E. infidus* also, and are, in reality, nothing more or less than the meconial pellets voided by the propupa.

In all essential respects the development of *E. infelix* appears to be identical with that of *E. infidus*.

Aphycus melanostomatus Timb.

Imms (1918) has given an account of *Aphycus melanostomatus* as a parasite of *Lecanium capreae* in England. In this species the early-stage larvae lie free in the body cavity of the host. No spiracles are present on the first two stages, while the third possesses nine pairs, which are situated on the second and third thoracic and the first seven abdominal segments. The departure from the normal habit occurs in this last stage, in which the larva is enveloped in a "sheath-like investment" which covers the entire body except the head, and is intimately connected with the tracheal system of the host. This sheath is said to arise as a proliferation of the chitin-forming cells of a trachea, probably as a result of injury or perforation by the parasite. The tracheal branches are intimately connected with this sheath and can be seen to open directly into the space between the innermost layer of the sheath and the body wall of the parasite within. Superficially, these branches have the appearance of arising from the body of the larva and ramifying through the tissues of the host.

It appears more probable that the "sheath-like investment," at least the innermost delicate chitinous layer, is in reality the skin of the preceding stage, and that the tracheal system mentioned is an adaptation somewhat similar to that described for *Encyrtus infidus*. This habit of pupation within the last larval skin has been recorded also as occurring in several species of Coccophagus (Timberlake, 1913, and Smith and Compere, 1926). In these cases the enveloping skin has been described as a protective shroud, filled with air, though no connection with the host tracheal system is mentioned in either case. From the fact that the puparia occur in the still-fluid contents of the living host it appears probable that some connection with its respiratory system must be made.

Carabunia myersi Waterston.

The account by Myers (1930) of the biology of *Carabunia myersi* as a parasite of frog-hopper nymphs (*Clastoptera undulata* Uhl.) in Cuba is of particular interest. The larval modifications in connection with respiration apparently represent an intermediate stage between the pedunculate form (*Microterys*, *Encyrtus*, etc.) and the caudate form (*Cerapterocerus*, *Cheiloneurus*, etc.), both of which types of larvae are found among the Encyrtidae.

The egg is of the stalked form, but lies free in the body cavity of the host. This stalk is apparently functionless after oviposition. At no time does the parasite larva achieve any connection with the body wall of the host, and consequently its air supply must be secured by osmotic action from the body fluids or through a direct connection with the host tracheal system. The early larval stages are of the caudate form, and the connection with the host tracheae is made towards the end of the last larval stage. The successive cast skins and the egg-shell remain as an envelope about the caudal end of the body in the same way as is seen in those species having a permanent connection with the host integument.

The first and second larval stages, though of the pronounced caudate form, have a well developed internal tracheal system, though no spiracles are present. In the early part of the third stage the tail is still quite evident, and this apparently functions until the connection with the host tracheal system is attained. In this stage there are three pairs of spiracles, one of which is anterior and the remaining two posterior. This arrangement

is identical with that of the corresponding stage of *E. infidus*. During this stage the spiracles, one by one, achieve a connection with the nearest abdominal tracheae of the host. The spiracle becomes greatly sclerotized and darkened, and is apparently raised above the substratum. There is stated to be no regularity in these tracheal attachments. "There is no connection whatever between the spiracular trunks (and lateral trunks) and the sclerotized spiracles with their host tracheal connections. Even the position of the sclerotized spiracles may not coincide with the end of the spiracular trunk which joined it before sclerotisation."

Pupation takes place within the partly sclerotized third larval integument, and the adult emerges from the still-living host.

The occurrence in Carabunia of the two distinct respiratory modifications is without a parallel in the family. From the caudate type in the first two stages there appears in the next stage a tracheal system bearing three pairs of spiracles, it being thus identical with that in the third stage of *E. infidus* and *E. infelix* except that the posterior pair are not borne upon extended spiracular trunks but are level with the substratum. The development from this point onward is similar to that of Encyrtus. From the account given by Myers it would appear that a fourth larval stage should intervene before pupation.

DESCRIPTIONS OF THE IMMATURE STAGES OF ENCYRTUS INFIDUS.

The Egg.—The main body of the egg is 0.32 mm. in length, nearly flat on the ventral side and distinctly arched dorsally. The stalk is 0.3 mm. long and irregularly enlarged at the distal end. On the dorsal side of the egg is what appears to be a waxy incrustation, which extends from the base of the stalk to three-fourths the length of the main body. It is also found upon the stalk for its entire length, and on both the egg body and the stalk it covers approximately one-fourth the circumference.

The First Stage Larva.—(Fig. B). The body comprises 12 visible segments, and is broadest in the mid-abdominal region. The tracheal system consists of two longitudinal trunks, with the usual anterior and posterior commissures, and a single pair of spiracles borne upon the last segment.

The Second Stage Larva.—Identical in form with the preceding stage.

The Third Stage Larva.—(Fig. C). The body with 13 visible segments instead of 12. The tracheal system with 3 pairs of spiracles,

the first situated on the anterior margin of the third thoracic segment, the second on the seventh abdominal segment, and the third pair at the end of long spiracular stalks which extend beyond the end of the body for one-half to two-thirds its length. The integument closely encases each of these stalks.

The Fourth Stage Larva.—The body form is normal for Encyrtidae of this stage. The tracheal system, however, bears only two pairs of spiracles, which are situated on the third thoracic and the eighth abdominal segments, respectively.

The Pupal Stage.—(Fig. D). Normal in form in all respects, and enveloped in the unbroken skin of the final larval stage.

SUMMARY.

Encyrtus infidus Rossi is parasitic in *Lecanium kunoensis* Kuw. in central Chosen (Korea), and produces two generations, and a partial third, each year upon the one host generation.

The gross parasitization effected in the field approximates 100 per cent, yet control is not effected, owing to the fact that the host females are able to deposit approximately half of their quota of eggs before death.

The manner of respiration in the last larval and pupal stages is unusual among Hymenoptera in that the air supply is derived from the tracheal system of the host by direct connection therewith.

In the spring generation pupation takes place within the unbroken larval skin in the living host. The death of the host results from mechanical injury at the time of emergence of the first parasite, rather than as a direct result of the feeding of the parasite larvae upon the body contents.

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EXPLANATION OF PLATE I.

Encyrtus infidus Rossi.

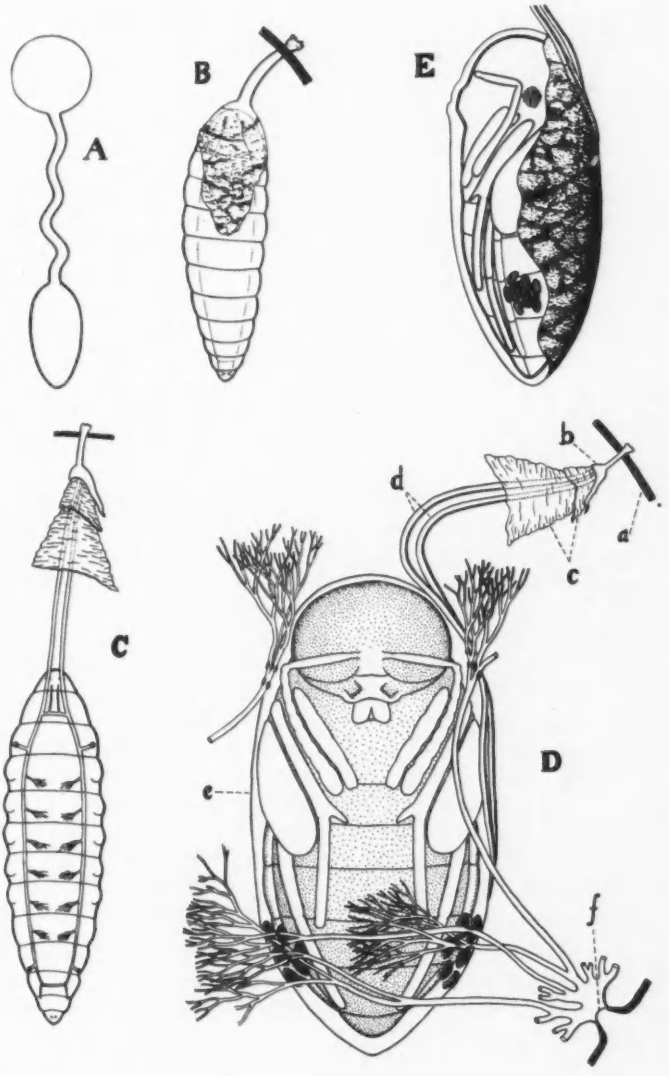
Fig. A.—The ovarian egg.

Fig. B.—The first-stage larva, showing the eggshell encasing the caudal segments.

Fig. C.—The third-stage larva, showing the long caudal spiracular trunks, with the terminal spiracles fixed in the cup-shaped exuvia of the preceding stages.

Fig. D.—Ventral view of the pupa within the "puparium," with the host details somewhat diagrammatic. *a*, the integument of the host; *b*, the egg-shell; *c*, the first and second larval exuvia; *d*, the spiracular trunks of the third exuvia; *e*, the unbroken skin of the fourth-stage larva, which envelops the pupa; and *f*, a spiracle of the host, showing several of the tracheae which arise from it and are fused with the spiracular areas of the fourth-stage larva.

Fig. E.—Lateral view of the pupa in the "puparium," showing the darkened exuvium of the third-stage larva on the dorsum and the meconial pellets grouped at the posterior spiracular area.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ARTHROPOD DESIGNS ON PREHISTORIC MIMBRES POTTERY.[1]

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In the southwest corner of New Mexico, north of Deming, lies the valley of the Rio Mimbres, a narrow strip of agricultural land between hills and bluffs. In this fertile valley have been found numerous ruins of a prehistoric Pueblo people who tilled the soil and developed an advanced culture several hundred years before the first white men reached America. Mr. Earl H. Morris, Research Associate of the Carnegie Institution of Washington, roughly estimates the date as about 1200 A. D. The archeology of the region has been discussed by J. Walter Fewkes[2] of the Bureau of American Ethnology.

One of the outstanding characteristics of their culture is the wealth of realistic animal forms used in decorating their pottery. Early explorers in the region describe the abundance of game animals, birds, and fishes, and this abundance is reflected in the designs painted on food bowls, large numbers of which have been recovered. Their art included, in addition to these realistic animal forms, a great variety of geometric motifs, all very exquisitely and accurately done.

The burial customs of these people have been described in the works noted above. The body was placed, sometimes in a sitting position but more often on the back, with the knees drawn upward and the arms pressed closely to their sides. Over the head, apparently as a protection for the skull, a bowl was frequently placed, and the grave then filled in, sometimes with clay. In order that the bowl might accompany its dead owner to the next world, it also was "killed" by having a hole broken through its bottom. It is

[1]Contribution from the Museum, University of Colorado.

[2]Archeology of the Lower Mimbres Valley, New Mexico. Smithsonian Misc. Collections, Vol. 63, No. 10, 1914.
Designs on Prehistoric Pottery from the Mimbres Valley, New Mexico. Smithsonian Misc. Collections, Vol. 74, No. 6. 1923.
Additional Designs on Prehistoric Mimbres Pottery. Smithsonian Misc. Collections, Vol. 76, No. 8. 1924.

these bowls which in large part have furnished the material for numerous collections which have been made, including that of Mr. Morris, collected for the University of Colorado, and from which the accompanying photographs were made.

The designs include a wide range of animal forms, comprising bears, deer, antelopes, mountain sheep, wolves, mountain lions, wild cats, rabbits, beavers, and bats, as well as man among the mammals. The birds which are easily recognizable are quail (both ordinary and crested forms), crane, turkey, parrot, swallow, and crow. Snakes, lizards, turtles, frogs, and a variety of fishes occur. These designs, portraying for the most part large and conspicuous animals, some of which were used as food, indicate an interest in living things which might be expected in a race living close to nature, and a rather exceptional ability to picture them in recognizable form.

While it is perhaps not remarkable that they should have observed these more conspicuous animals it is certainly worthy of note that they were equally well acquainted with the smaller and less conspicuous forms, the insects and arthropods in general. These are very well represented, and it is the opinion of Mr. Morris that insects were not used as food by these people. If such is the case, it is still more remarkable to find such a wealth of arthropod designs, indicating a more or less purely aesthetic appreciation of the forms of these animals.

Figure 1 represents a common whip scorpion such as may still be found in the Mimbres Valley. The aboriginal inhabitants were undoubtedly well acquainted with the painful and poisonous wound which these animals are capable of inflicting and this fact probably made them of sufficient importance to warrant their use as a decorative design.

While the Mimbres River is not a large stream except during the rainy season, there are swampy places along its course which furnish breeding grounds for numerous insects which spend a part or all of their life cycle in the water. Figure 2 represents undoubtedly one of the dragonflies, common in that region at the present time. The large, transversely-placed eyes, the wide-spread, barred wings, and the segmented abdomen are typical of the Odonata, but the large antennae are somewhat out of place on this form. This illustrates a tendency observed in many of the designs to represent by a short-hand symbolism additional information about the animal.

Antennae seem very frequently to have been employed to indicate that the animal under consideration belonged to the insect group, whether the antennae supplied are appropriate to the particular insect or not.

In a moist, fertile valley with pools where the early stages in the life history may be passed it is to be expected that mosquitoes would abound, and Figure 3 indicates that the prehistoric inhabitants of the region had the presence of these pests brought to their attention in much the same fashion as they are to ours.

Figure 4 illustrates, in my opinion, the same type of symbolism as is illustrated by the conspicuous antennae on the dragonfly. This figure probably represents an insect form, as witness the antennae and the odonatan eyes. The body of the animal is decorated with the usual conventionalized geometric design, and the fish-like tail is doubtless meant to indicate that the insect is an aquatic form, probably a dragonfly nymph.

Even a superficial examination of the art of these people as represented on their pottery leads us to believe that they had an appreciation of the beauty of living things completely out of proportion to what we might expect from a relatively primitive and simple culture. It seems a singular circumstance that a culture of this type could have so completely vanished in a few hundred years, so that the earliest historic records should show nothing but ruins in the Mimbres Valley.

EXPLANATION OF PLATES.

PLATE I.

FIG. 1. Whip Scorpion. Food bowl from the Mimbres Valley, New Mexico. Univ. of Colo. Mus. Cat. No. 3154.

FIG. 2. Dragonfly. Showing conventionalized antennae which indicate that the animal is an insect. Univ. of Colo. Mus. Cat. No. 3138.

PLATE II.

FIG. 3. Swarm of Mosquitoes. Showing hole punched in the bottom to "kill" the bowl. Univ. of Colo. Mus. Cat. No. 3264.

FIG. 4. Aquatic Insect Larva. The conventionalized fish tail indicates that the animal lived in the water. Univ. of Colo. Mus. Cat. No. 3089.

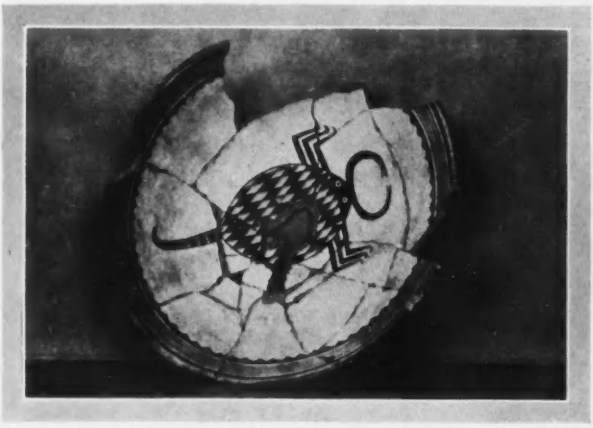

FIGURE 1

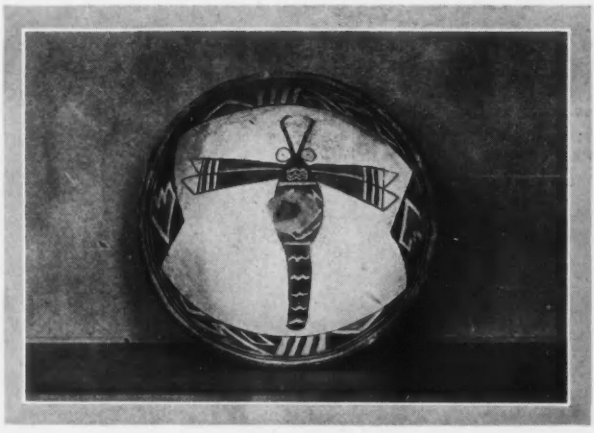

FIGURE 2

FIGURE 3

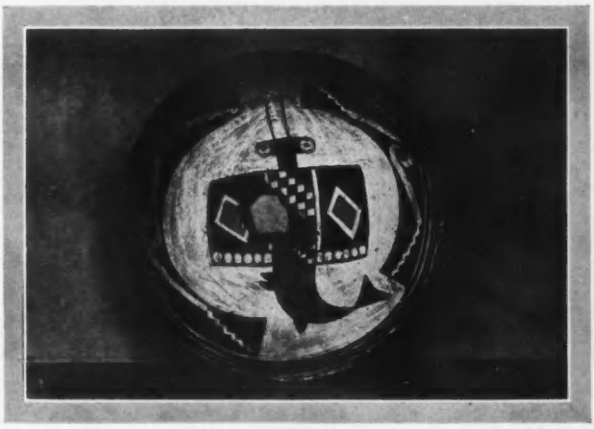

FIGURE 4

RECORDS OF SOME INSECTS PREDACIOUS ON EPILACHNA CORRUPTA MULS. IN MEXICO.

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During the summer of 1930 a great many insects were found associated with *Epilachna corrupta* Muls. on bean foliage, with *E. obscuriella* Muls. on beans and squash, and with *E. defecta* Muls. and *E. mexicana* Guer. on wild solanaceous plants, in the Republic of Mexico. In many instances these insects were observed feeding on the immature stages of Epilachninae in the field. Other insects captured on, or near, beans and suspected of preying on *E. corrupta* were brought to the laboratory of Tropical and Subtropical Insects and La Defensa Agricola in cooperation with Truck Crop Insect Investigations in Mexico City, and placed in cages with immature stages of *corrupta*, where their habits were observed. Twenty-one species of insects were found to feed on *E. corrupta* under these conditions.* No attempt has been made to find additional hosts of these predators in the field, laboratory, or literature. It seems probable, however, that many of them attack insects other than Epilachninae.

Many of the species were taken at Cuernavaca, Morelos, although collections at Cordoba, Guadalajara, Oxaca, and Puebla added greatly to the total number of species obtained.

METHOD OF COLLECTING INSECTS.

Late in the summer, when these predators appeared in numbers, notes were taken of the quantity of food consumed daily by individuals of each species. Field-collected material was confined in small Petri dishes or glass mason jars with screened tops. Known numbers and stages of *E. corrupta* were confined in these containers in the laboratory. Wet pieces of blotting paper furnished the necessary moisture. Fresh bean foliage was supplied daily for the *E. corrupta* larvae. The temperature in the laboratory varied but slightly from

*To H. G. Barber, L. L. Buchanan, and E. A. Chapin, of the Division of Taxonomy, United States Bureau of Entomology, thanks are due for the determinations of Hemiptera, Carabidae, and Cleridae, respectively.

17° C. Late in September the predators were taken to Columbus, Ohio, where they were fed and observed until the last of October.

Considerable data were obtained on the quantities of food consumed for a large number of hemipterous predators. An individual of *E. corrupta* was considered eaten when it had been sucked dry and only the sclerotized exoskeleton was left. In the case of the carabid species the food was entirely consumed. Although *E. corrupta* in the egg stage would undoubtedly have been acceptable to many of the predators, this was not

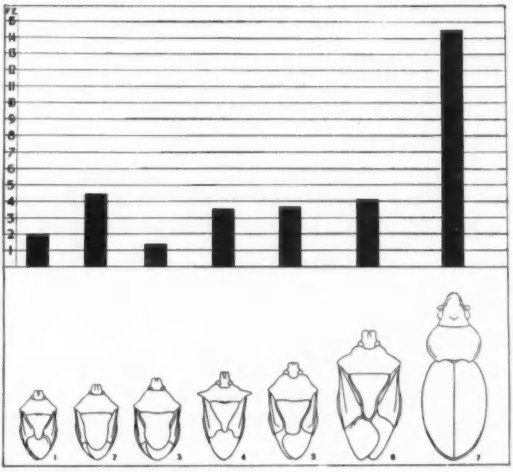

FIGURE 1. Daily consumption of *E. corrupta* by predators, in food equivalents (F. E.): 1, *Perillus confluens;* 2, *Stiretrus anchorago;* 3, *Stiretrus caeruleus;* 4, *Podisus sagitta;* 5, *Oplomus dichrous;* 6, *Podisus lineolatus;* 7, *Calosoma laeve.*

determined. The usual practice was to expose larvae or pupae to the predators, although in a few cases adults were introduced into the containers.

Podisus sagitta (Fab.), *Oplomus dichrous* H. S., and *Podisus lineolatus* (H. S.) were cannibalistic in the late immature stages. Nymphs rendered inactive and delicate during the molting process were apparently preferred as food to stages of *E. corrupta* in many instances.

Several species of pentatomids were reared for more than one generation in the laboratory. Species appearing late in the

season, or in small numbers throughout the season, were not always reared through a complete generation.

E. corrupta was the only host used in the laboratory. It was not always possible to supply a large number of individuals of this host of the same size and stage. For this reason it would be impossible to collate the value of the several species of predators without reducing the quantity of food consumed to some standard measure. In order to condense these data and express the different food requirements of the several species in comparable values, a number of individuals of *E. corrupta* of the third instar to adult stage, inclusive, were weighed and their relationship thereby established. By arbitrarily assigning a value of 1 to a third-instar larva, the other stages and sizes have the following comparable values: Small fourth-instar larva, 2; medium fourth-instar larva, 4; large fourth-instar larva, 6; pupa, 4; adult, 3. This means that a small fourth-instar larva weighs twice as much as a medium third-instar larva; a medium fourth-instar larva four times as much as an average-sized third-instar larva, etc. Inasmuch as the sclerotized exoskeletons are the only parts of the insects not eaten by the predators (Calosoma excluded), there is a greater discrepancy in the figure assigned to the adult than in that for any other stage because the adult has more sclerotized body parts than any of the immature forms. However, since the number of adults consumed was very small, this point is of slight importance. By means of the values assigned above, "food equivalents" have been determined from the actual laboratory data. A food equivalent may be defined as the quantity of food consumed by one individual in one day. The average food equivalent consumed by a single individual is determined by averaging the total food consumed by all the adults in one container. A comparison of the food equivalents consumed by the various predators is shown in Figure 1.

FAMILY PENTATOMIDAE.

Podisus sagitta (Fab.).

This pentatomid was the most abundant of the predacious insects attacking *E. corrupta* at Cuernavaca, Morelos. Adults were collected in the field there from August 1 until late September. In the fields at Amecameca, Mexico, and at Chalco

and other localities within the Federal District, it was present, but scarce, during late August and early September.

TABLE I.

Food Consumed by Nymphs of *Podisus sagitta.*

Stage	Number of Nymphs	Date	Food Consumed	Food Equivalent
Hatched	42	Aug. 7	(No larvae eaten in this stage)	0
Molt 1		Aug. 18		
	40	18–20	15 large second instar larvae*	0.09
	33	20–23	5 first,† 2 second, 4 third instar larvae	0.06
	32	23–25	7 third instar larvae	0.10
Molt 2		Aug. 27–31		
	32	25–28	2 first, 2 third, 2 medium fourth instar larvae	1.09
	30	28–30	1 second, 6 medium fourth instar larvae	0.40
	30	30–31	5 third, 1 large fourth instar larvae	0.36
	30	Aug. 31 to Sept. 2	2 large fourth instar larvae	0.20
Molt 3		Sept. 4–10		
	27	2–6	1 third, 6 large fourth instar larvae	0.34
	27	6–8	5 large fourth instar larvae, 1 pupa	0.62
	18	8–10	8 medium fourth instar larvae	0.94
Molt 4		Sept. 11–19		
	17	10–13	1 third, 5 medium fourth, 2 large fourth instar larvae	0.64
	17	13–17	5 medium fourth, 18 large fourth instar larvae	1.88
	17	17–19	7 medium fourth, 7 large fourth instar larvae, 1 pupa	2.17
	17	19–22	7 medium fourth, 5 large fourth instar larvae	0.82
Final molt	15	Sept. 24–28 Sept. 22 to Oct. 1	14 medium fourth, 9 large fourth instar larvae, 19 pupae	1.46

*A second-stage larva is given an arbitrary value of 0.50.
†A first-stage larva is given an arbitrary value of 0.25.

This species laid its eggs in masses consisting of from 20 to 50 each. The incubation period was found to be 12 days in length. The entire life cycle was completed under laboratory

conditions in from 62 to 64 days. The long developmental period seems to be largely responsible for the scarcity of this and related species in the field until the peak of bean-beetle infestation has passed.

The records of the quantity of food consumed by diminishing numbers of nymphs of *P. sagitta* given in Table I show the value of this pentatomid as a predator of *E. corrupta*. Unfortunately, the food consumed throughout a single nymphal stage is not shown exactly, since some of the nymphs spend more time in any one stage than others hatched from the same egg mass. The range of days during which molting took place is indicated.

First-stage nymphs of all species of pentatomids observed failed to feed on larvae of *E. corrupta*. As soon as the first molt occurred the nymphs attacked the larvae. It was also noted that the nymphs fed little, if any, on the day prior to a molt. This is not shown to any great extent in the data given above, because the molt extended over several days for a group of nymphs of the same age.

The nymphs of *P. sagitta* are voracious eaters. For example, when the seven third-instar larvae of *E. corrupta* were introduced on August 23, the 33 half-grown nymphs immediately attacked and killed them all. They were observed with their beaks remaining in the same larva for several hours. At one time 10 nymphs were feeding on a single larva.

A summary of the data obtained for adults of this species is given below:

Number of containers	13
Number of individuals	45
Length of life in the laboratory, days	44 to 3
Food equivalent	3.53
Extremes of food equivalents	12.0 to 0.28

The number of individuals of all species gradually diminished during the period they were held in the laboratory and observations were continued until all the adults had died. The length of life and the equivalent quantities of food consumed varied considerably owing in part to the age, sex, and size of the adults. The average daily food equivalent consumed by *P. sagitta* is 3½ third-instar *E. corrupta* larvae.

Podisus lineolatus (H. S.).

This large gray species was second in abundance among the pentatomids preying on *E. corrupta* at Cuernavaca, Morelos. The first adults were collected on August 1, and later collections were made late in August and early in September. Late in August and September they were also found in bean fields at Chalco, D. F. No complete life history for this species was obtained in the laboratory, but the data shown in Table II

TABLE II.

Food Consumed by Nymphs of *Podisus lineolatus*.

Stage	Number of Nymphs	Date	Food Consumed	Food Equivalent
Collected	18	Sept. 1	(First instar nymphs, no food consumed.)	
Molt 1	18	Sept. 5–6		
	18	5–9	2 third, 7 medium fourth instar larvae	0.25
	18	9–10	2 medium, 1 large fourth instar larvae	0.77
Molt 2		Sept. 10–12		
	16	10–12	6 medium fourth instar larvae	0.75
	16	12–16	9 medium fourth instar larvae	0.56
Molt 3		Sept. 14–16		
	16	16–19	14 medium fourth, 6 large fourth instar larvae	1.91
	16	19–21	7 large fourth instar larvae, 1 pupa	1.43
Molt 4		Sept. 24–27		
	15	Sept. 21 to Oct. 1	12 medium fourth, 12 large fourth instar larvae, 4 pupae	0.90
	15	1–2	7 medium fourth instar larvae	1.86
	15	2–5	12 large fourth, 3 medium fourth instar larvae	2.38
	15	5–12	6 pupae, 1 adult, 15 large, 9 medium fourth instar larvae.	2.00
Final molt		Oct. 6–12		

indicate that it is somewhat shorter than that of *P. sagitta*. One egg mass of 93 eggs was the single oviposition record procured.

The records for the nymphs of this species (Table II) show the increasing quantities of food consumed by each nymph as it

approached maturity. The greatest quantities of food were usually consumed when the nymph in any stage of development was about half grown.

Data pertaining to the adults of *P. lineolatus* are summarized below:

Number of containers	10
Number of individuals	31
Length of life in laboratory, days	35 to 2
Food equivalent	4.13
Extremes of food equivalents	8.57 to 1.0

Oplomus dichrous (H. S.).

Adults of this species were collected in bean fields at Cuernavaca, Morelos, and Cholula, Puebla, during August and September. This species is slightly smaller than *Podisus lineolatus* and larger than *P. sagitta*. The adults are extremely variable in color pattern and some individuals superficially resemble *O. tripustulatus* (Fab.).

Masses of 5 to 48 eggs were laid in the laboratory. The incubation period ranged from 18 to 22 days. The entire life cycle, egg to adult, of the two lots of nymphs whose records appear in Table III (Page 702) was found to be 64 to 66 and 58 days, respectively. This period is comparable with that of *P. sagitta*.

A summary of data concerning the adults of *O. dichrous* is given below:

Number of containers	8
Number of individuals	25
Length of life in laboratory, days	39 to 2
Food equivalent	3.67
Extremes of food equivalents	16 to 0.5

The food equivalent of 3.67 is much the same as the 4.13 obtained for *Podisus lineolatus*, a species of similar size.

Oplomus nigripennis pulcher Dall.

This pentatomid resembles certain individuals of *Oplomus dichrous*. An adult was observed feeding on larvae of *E. mexicana* at Cordoba, Vera Cruz, on July 3.

Stiretrus anchorago (Fab.).

This pentatomid was found to be widely distributed. It was taken at Cordoba, Vera Cruz, on July 3; Puente de Ixtla, Morelos, on July 25; Oaxaca City, Oaxaca, on August 22; and at Cuernavaca, Morelos, during September.

TABLE III.

Food Consumed by Nymphs of *Oplomus dichrous*.

FIRST LOT.

Stage	Number of Nymphs	Date	Food Consumed	Food Equivalent
Eggs laid		July 31		
Hatched	12	Aug. 22–23	(No larvae consumed by first stage nymphs)	
Molt 1		Aug. 29–30		
	12	30–31	2 first, 4 third instar larvae	0.37
	12	Aug. 31 to Sept. 10	2 third, 11 medium fourth instar larvae	0.38
Molt 2		Sept. 6–12		
	11	10–14	5 large fourth instar larvae, 1 pupa	0.77
Molt 3		Sept. 12–14		
	10	14–17	8 medium fourth, 7 large fourth instar larvae	2.46
	10	17–22	9 medium fourth instar larvae	0.72
Molt 4		Sept. 20–24		
	10	22–23	4 large fourth instar larvae	3.6
	9	23–25	6 large fourth instar larvae, 2 pupae	2.44
	6	26–28	No larvae; 3 nymphs eaten.	
	6	Sept. 28 to Oct. 1	19 medium fourth instar larvae, 2 pupae	4.66
Final molt		Oct. 3–5		

SECOND LOT.

Eggs laid		Aug. 8		
Hatched	10	26–27	(No larvae consumed by first stage nymphs)	
Molt 1		Sept. 2		
	9	2–12	7 large fourth instar larvae	0.46
Molt 2		Sept. 10–11		
	7	12–14	2 third, 6 medium fourth instar larvae	1.85
	6	14–17	3 large fourth instar larvae	1.00
Molt 3		Sept. 16–17		
	6	17–19	9 large fourth instar larvae, 1 pupa	4.83
Molt 4		Sept. 25–27		
	6	Sept. 19 to Oct. 1	12 medium fourth, 14 large fourth instar larvae, 13 pupae	2.55
	5	1–7	1 small fourth, 8 large fourth instar larvae, 1 pupa	1.80
Final molt		Oct. 5		

Nine second-stage nymphs were brought to Mexico City from Oaxaca City and their record is given in Table IV.

TABLE IV.

Food Consumed by Nymphs of *Stiretrus anchorago*.

Stage	Number of Nymphs	Date	Food Consumed	Food Equivalent
Second stage collected		Aug. 22		
	9	24	3 third instar larvae	0.33
	9	24–26	3 third instar larvae	0.16
	9	26–30	3 third, 1 medium fourth instar larvae	0.16
Molt 2		Aug. 29–30		
	9	30–31	4 third instar larvae	0.11
	9	Aug. 31 to Sept. 1	6 third instar larvae	0.66
Molt 3		Aug. 6–8		
	9	2–7	5 medium fourth instar larvae	0.44
	9	7–8	2 medium fourth instar larvae	0.88
	9	8–9	3 large fourth instar larvae	2.00
	9	9–10	4 medium fourth instar larvae	1.77
Molt 4		Aug. 13–16		
	9	10–16	18 medium fourth instar larvae	1.33
	9	16–17	7 medium fourth instar larvae	3.11
	9	17–18	6 large fourth instar larvae	4.00
	9	18–19	5 large fourth instar larvae	3.33
	9	19–21	6 medium fourth instar larvae	1.33
	9	Sept. 21 to Oct. 1	10 medium fourth, 4 large fourth instar larvae	0.71
Final molt		Sept. 28–29		

Table IV shows that increasing quantities of food are consumed by each nymph as it approaches maturity. It also indicates that the greatest quantity of food is consumed when the nymphs of any one stage are half grown.

The food consumed by adults of *S. anchorago* is summarized as follows:

Number of containers 2
Number of individuals 10
Length of life in laboratory, days ..... 45 to 2
Food equivalent 4.40
Extremes of food equivalent ..... 7.60 to 0.66

It is seen in Figure 1 that the food equivalent of this species is quite high compared with that of other pentatomids of a similar size.

S. anchorago was kept in the laboratory in 4-inch Petri dishes with greater success than were other species. The 9 second-stage nymphs collected on August 22 at Oaxaca City survived and molted en route to, or at, Columbus, Ohio, between September 28 and 29. Later the adults produced viable eggs. Some of the 9 adults deposited 21 masses of eggs, in the container, consisting of 4 to 21 eggs each, the average being 14 eggs per mass. The last adult died on October 22.

Stiretrus caeruleus Dall.

Adults of this species were collected at Cordoba, Vera Cruz, on July 3; at Guadalajara, Jalisco, on August 8; and at Cuernavaca, and Puente de Ixtla, Morelos, on August 10 and 25, respectively. A few adults were collected at Xochimilco and Chalco, D. F., during the summer. At Cordoba and Puente de Ixtla they were found associated with *Epilachna mexicana* and at Guadalajara and Cuernavaca they were found on bean foliage.

This species differs from *S. anchorago* in that it appears to have a longer life and a lower food equivalent. One female deposited a mass of 8 eggs and later a mass of 13 eggs.

The food consumed by adults of *S. caeruleus* is summarized as follows:

Number of containers	3
Number of individuals	8
Length of life in laboratory, days	70 to 11
Food equivalent	1.38
Extremes of equivalent	6.0 to 0.33

Although one adult lived 70 days, this longevity record does not compensate for the low equivalent quantity of food (1.38) consumed per day per adult. *S. anchorago*, with an adult food equivalent of 4.40, would appear to be over three times as effective as *S. caeruleus*.

Perillus confluens (H. S.).

This species was taken at Xochimilco, D. F., on July 24; at Chalco, D. F., on August 18; and at Cuernavaca, Morelos, on September 1. One second-stage nymph was collected at Chalco on August 31. The final molt occurred October 7. During these 42 days it consumed 11 large and 6 medium-sized fourth-instar *E. corrupta* larvae.

A summary of food consumed by adults of *P. confluens* is as follows:

Number of containers	6
Number of individuals	7
Length of life in laboratory, days	52 to 4
Food equivalent	1.98
Extremes of equivalents	6.0 to 0.66

P. confluens with a food equivalent of 1.98 would seem to be slightly more valuable as a predator than the larger *Stiretrus caeruleus*, which has a food equivalent of 1.38.

Perillus bioculatus (Fab.).

A few of these pentatomids were collected at Chalco, D. F., late in the season. One adult consumed 8 large fourth-instar larvae and 3 third-instar larvae in 11 days. A mass of 17 eggs was laid in the laboratory.

Perillus virgatus Stal.

This species was sparsely present at Xochimilco and Chalco, D. F., late in July, in August, and early in September. It was taken at Cuernavaca, Morelos, early in August. One nymph collected at Chalco early in September molted the last time on October 2. From September 14 to October 12 it consumed 12 large and 4 medium-sized fourth-instar larvae. Two large fourth-instar larvae were consumed by the adult in 3 days.

Euthyrhynchus floridanus (L.).

This brightly colored pentatomid was observed feeding on larvae of *E. defecta* at Cordoba, Vera Cruz, on July 3.

Piezodorus guildinii (Westw.).

Although this pentatomid is not generally considered to be predacious, an adult collected at Cuernavaca on August 11 ate 2 medium-sized fourth-instar larvae during the 17 days it lived in the laboratory.

PENTATOMIDS NOT PREDACIOUS ON E. CORRUPTA.

Phineus fuscopunctatus Stal. and *Padaeus irroratus* (H. S.) collected at Chalco on August 3; *Mormidea notulata* H. S., *Hymenarcys reticulata* Stal, and *Galgupha coerulescens* Stal, at Cuernavaca on September 1; *Solubea pugnax* (Fab.), at Cuer-

navaca in August and September; *Edessa patricia* Stal (?), at Chalco in August; *Nezara viridula* (L.), at Cuernavaca on August 24; *Acrosternum marginatum* (P. B.), at Oaxaca City on August 22; *Euschistus biformis* Stal. and *E. rugifer* Stal, at Cuernavaca and Chalco in August and September; and *E. comptus* Walk., at Oaxaca City on August 22.

FAMILY REDUVIIDAE.

An adult, *Sinea confusa* Caud., collected at Cuernavaca on September 6, consumed 1 third-instar larva during the 11 days it lived in confinement.

One adult, *Zelus rubidus* L. S., collected at Cuernavaca on August 10, devoured 1 medium-sized fourth-instar larva and 1 third-instar larva in 8 days.

An adult, *Pselliopus zebra* (Stal), collected at Cuernavaca on September 6, consumed 3 small fourth-instar larvae in 13 days.

One specimen of *Apiomerus pictipes* H. S. was taken at Cordoba, Vera Cruz, on July 3, where it was feeding on a larva of *E. defecta*. It fed on larvae of *E. corrupta* in the laboratory, where it lived 24 days.

Apiomerus longispinis Champ., collected at Cuernavaca on August 24, would not feed on larvae of *E. corrupta*.

Castolus plagiaticollis Stal was collected at Cordoba on July 3, where it was found associated with *E. defecta*.

From the above records it appears that reduviids are not of great importance in the control of *E. corrupta* in the vicinity of Mexico City.

FEEDING HABITS OF OTHER HEMIPTERA.

A coreid, *Anasa denticulata* Stal (?) was observed feeding on a larva of *E. defecta* at Puente de Ixtla, Morelos, on July 25. Another specimen collected at the same locality on August 24 did not feed during the time it was held in the laboratory.

Another coreid, *Anasa maculipes* Stal, was taken at Cuernavaca on August 1. This adult devoured 2 medium-sized fourth-instar larvae during the 13 days it lived in the laboratory.

A corizid, *Harmostes nebulosus* Stal, and a coreid, *Zicca* sp., were collected at Cuernavaca on September 1. Unfortunately these were kept in the same feeding jar. In three days one, or both of them together, devoured 1 medium-sized fourth-instar larva.

A coreid, *Phthia picta* (Drury), in the nymphal stage, collected on August 10 at Cuernavaca, consumed 4 small fourth-instar larvae in 12 days.

COLEOPTERA.

Adults of the large, black carabid, *Calosoma laeve* Chev., were occasionally present in the bean fields of Cuernavaca, Morelos, and Chalco, D. F., late in the summer. Although the larvae of this species were not observed, they are believed to be predacious. Adults kept under laboratory conditions consumed large quantities of food.

Data concerning *Calosoma laeve* adults are given below:

Number of containers	3
Number of individuals	3
Length of life in laboratory, days	35, 21, 11
Food equivalent	14.56

Another carabid, *Onypterygia thoreyi* Mann., was found on corn at Cuernavaca on August 1. During the 16 days it was held in the laboratory it partly devoured 2 fourth-instar larvae.

A clerid, *Enoclerus bombycinus* Chev., was taken September 8 at Chalco, D. F., at which time it was observed holding a dead adult of *E. corrupta* in its mandibles. This specimen lived 18 days in the laboratory and consumed part of one adult beetle. It is not known if this adult was dead or alive when attacked.

SUMMARY AND CONCLUSIONS.

Several species of Hemiptera and Coleoptera were observed to be associated with *E. corrupta*, *E. defecta*, *E. mexicana*, and *E. obscuriella* in various parts of Mexico. Various stages were collected in the field and brought to the laboratory at Mexico City, where efforts were made to induce them to feed on immature stages of *E. corrupta*. Several species consumed large numbers of this insect, thus indicating their importance in the natural control of the bean beetle.

The first-stage nymphs of pentatomids were not found to be predacious. The quantity of food consumed by growing nymphs in other stages of development appeared to be greatest about midway between the molts. Little, if any, food was taken for a day prior to a molt. Nymphs of most species were cannibalistic, especially when one of their number was rendered defenseless during the process of molting.

The quantity of food consumed by several species of adult pentatomids varied considerably, even among species of similar sizes. The food equivalents range from 4.40 for *Stiretrus anchorago* through 4.13 for *Podisus lineolatus*, 3.67 for *Oplomus dichrous*, 3.53 for *Podisus sagitta*, 1.98 for *Perillus confluens*, to 1.38 for *Stiretrus caeruleus*. A carabid, *Calosoma laeve*, had a high food equivalent of 14.56. (Fig. 1.)

One adult pentatomid, *Stiretrus caeruleus*, lived in the laboratory as long as 70 days. Most of the adults lived from 20 to 40 days.

The life cycle, egg to adult, was found to be between 58 and 64 to 66 days, respectively, for two lots of *Oplomus dichrous*, and 62 to 64 days for one group of *Podisus sagitta*.

The following pentatomids were also found to be predacious: *Oplomus nigripennis pulcher* on *E. mexicana; Euthyrhynchus floridanus* on *E. defecta; Piezodorus guildinii*, *Perillus virgatus*, and *P. bioculatus* on *E. corrupta*. Several nonpredacious pentatomids were also collected.

Records concerning the food habits of the reduviids are given for the following species: *Sinea confusa*, *Zelus rubidus*, *Pselliopus zebra*, *Apiomerus pictipes*, *A. longispinis*, and *Castolus plagiaticollis*. Records for the three coreids, *Anasa denticulata*, *A. maculipes*, and *Phthia picta*, are included, as well as some doubtful records concerning the corizid *Harmostes nebulosus* and the coreid *Zicca sp.*

The carabid *Onypterygia thoreyi* and the clerid *Enoclerus bombycinus* may not, under different conditions, prove to be predacious as far as *E. corrupta* is concerned.

In the vicinity of Mexico City the life cycle of these pentatomids was several days longer than that of a single generation of *E. corrupta*. The peak of the larval population of the bean beetle is reached and damage to bean foliage accomplished before an appreciable number of pentatomids appear in the fields. As the winter survival of *E. corrupta* in most parts of the infested areas of Mexico is high, it is likely that the number of *E. corrupta* destroyed by predators during the late summer does not greatly reduce the numbers of beetles necessary to maintain the bean beetle the following season. Although *Stiretrus anchorago* and *Perillus bioculatus* are present in the United States, they play only a small part in the control of *E. corrupta*, although the former species becomes rather abundant as a rule in late summer in the Southern States.

THE PUPA-CASE BUILDING ACTIVITIES OF PASSALUS CORNUTUS FAB. (LAMELLICORNIA).

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The social reactions of the horned passalus, *Passalus cornutus* Fab., are of particular interest in that it is one of the few social Coleoptera.

The life-cycle of this beetle is normally passed within decaying wood where it is safely hidden from light and observation. One of the difficulties encountered in rearing these insects was the perfection of a method whereby normal reactions could be carefully observed. It was finally discovered that by using decaying sawdust of the right degree as a medium for galleries, and feeding the proper kind of decaying wood in amounts too small for the adults to burrow in and conceal themselves, the actions of both adults and larvae could be satisfactorily observed. Enameled cake plates approximately 2 inches deep were used for brood dishes. Pieces of window glass were used to cover the plates, and pieces of cardboard were then placed on the glass to exclude the light. Great care was necessary to prevent the accumulation of refuse in the brood dishes as the adults showed a tendency to plaster over the glass covers and thus prevent observation of their activities. A satisfactory humidity was maintained in the brood dishes by the daily saturation of small pieces of sponge resting on the sawdust in the brood dishes. By removing the cardboard the activities of the larvae and adults could be observed through the glass. It was found that the greatest activity occurred at night, and that artificial light did not interfere with their activities if it was not too intense. By placing a binocular microscope on the window glass covering the brood dish, and adjusting it to focus through the glass one could get a very interesting picture of the actions of any specimen. Great care was necessary, however, in moving the microscope in order not to jar the dish and disturb the individuals to be observed.

While the social relations of Passalus are interesting at all phases of its life-cycle, it is during the construction of the

pupa-cases that a very striking behavior occurs. As a larva of the last instar approaches the transformation to the pupa it comes to rest in a protected place, preferably under some object such as a piece of bark, wood, sponge, or against the glass cover, providing the refuse in the dish is high enough for the case to be built against it. Otherwise the case is constructed in the decaying refuse anywhere in the brood dish. The larva first scoops out a cavity in the refuse by means of its head and feet. The alimentary canal of the larva then gradually clears, the body becomes more curved, rigid, sluggish in movement, deeply indented, and thickly invested with fatty tissue. It is then that a very interesting reaction takes place. The adults push up large quantities of damp refuse on all sides of the cavity formed by the larva. The larva then starts work on the inside of the case and the adults build and shape the case from without. The construction is not a haphazard affair, but proceeds with surprising regularity. The adults (or adult, as occasionally only one individual assists with the building) do not deluge the larva with great quantities of material but continually push up and pack small amounts of material as the larva progresses on the inside. Pressure is applied simultaneously on both sides of the wall so that the case when finished is of sufficient strength to support any reasonable amount of debris placed upon it. The wall of the case is built up of concentric tiers one upon the other. Considerable moisture is exuded from the mouth of the larva and this aids materially in smoothing the surface of the inside of the case. The larva working from within and the adults from without add or take off material until the walls are extremely uniform. Cases not constructed on a side of the brood dish are symmetrically egg-shaped and are about 3½ centimeters in length by 2 centimeters in width. The larva changes ends within the case occasionally, but as a rule lies on its side with the last three or four posterior body-segments curved sharply under, until the time of the last larval ecdysis and the subsequent transformation of the pupa. Occasionally an adult exerts too much pressure in smoothing the completed case and breaks through. It immediately withdraws, pushes up more material and patches up the break in the wall. Runways are constructed around the case and all refuse is cleared away so that the case becomes very smooth.

In sawdust piles located in the woods and frequented by Passalus, the cases are generally constructed in the sides of galleries, and there is not such an elaborate system of runways around them as in the laboratory dishes. The cases are very symmetrical and firmly constructed.

For purpose of observation, several pupa-cases were opened and glass tops inserted. These were immediately plastered over. Another time several fully grown larvae were transferred to cases moulded by hand as near like the original as possible. These cases were promptly and very severely remodeled by the adults.

An artificial pupa-case was finally devised out of wet blotting paper and fitted with a removable glass cover. This could be placed on a binocular platform and the interior of the case subjected to magnification. Larvae transferred to this type of case went through the pupal changes without injury and proved very interesting as they changed their external appearance from time to time.

As the developing individuals pass through the pupal period the adults guard the cases and are constantly prowling through the runways and driving intruding larvae from the proximity of the cases. The adults show fight at the least disturbance and occasionally engage in battle with one another.

As the final ecdysis of the pupa takes place on the average of 10 days after the last larval ecdysis, it can be seen that unusual protection is shown the pupa during this period.

There seems to be no marked tendency for individuals of one sex to interest themselves more than the other in the care of the young. Various combinations of adults, from one pair to several individuals of the same sex, have been observed caring for the young. One of the most successful broods in the laboratory was cared for by two males and at no time did there appear to be any difficulty between them. In this instance the pupa-cases had been carefully constructed and all of the individuals passed successfully through the pupal stage. This fact, of course, serves to emphasize the remarkable degree of socialization which has developed in these interesting beetles. In many cases the galleries of various broods connect and there seems to be a sort of communal care of the young judged from the sex of adults taken with various broods.

Cannibalism is very prevalent and forms one of the greatest difficulties in carrying out observations on any particular larva. The adults generally confined cannibalism to eggs and first instar larvae although in some cases newly emerged adults were devoured while the bodies were still soft and the elytra pliable. There has been no observation of adults attacking pupae within their cases and it would seem that the cases are the protection against this practice.

Although clumsy and awkward in many of its movements, Passalus is readily adaptable to the laboratory when provided with the proper food and humidity, and forms an extremely interesting example of social life among the Coleoptera.

BOOK NOTICES.

LES COAPTATIONS CHEZ LES INSECTES. By JEAN CORSET, pp. 1–337, 1931. Published as Supplement au Bulletin Biologique de France et de Belgique, Paris.

This volume may be of interest to students of the evolution of insects and their many and curious adaptations. The term, "coaptation," is used to indicate the reciprocal adjustment of independent parts to form an apparatus with a definite function. The material is drawn largely from the Coleoptera. The author does not believe that Lamarkian or Darwinian explanations, or mutations can account for the facts. He holds that the development of coaptations demands an intelligence transcending any mechanistic theory! We are not out of the woods yet.—C. H. K.

MEDICAL ENTOMOLOGY, by ROBERT MATHESON, pp. I–XIV, 1–489, 211 text figures. Published by Chas. C. Thomas, Springfield, Illinois. 1931.

This beautifully printed and well bound volume has several features of its content and arrangement that will appeal to the student of medical entomology. Chapter I is introductory, giving a general history of the subject and various examples of the relation of arthropods to human disease. The chapter closes with six pages of general references which include the books and journals of special interest. This appears to be a feature very useful to the teacher and student. Chapters II–XVIII are the body of the work and cover the general subject under the usual systematic arrangement of the host arthropods. While all forms of arthropods known to be hosts are treated in order and each section is followed by a carefully selected bibliography the main emphasis is on Diptera (pp. 174–409). This is in the field in which the author has done much research in recent years and is as it should be. Chapters X, XI, and XII on mosquitoes are probably the high part of the volume. Chapter XVIII is on Siphonaptera, Chapter XIX on poisonous and urticating arthropods and Chapter XX on collecting, preserving and mounting insects. The volume closes with a very complete index. For the general entomologist the book has many excellent figures of insect anatomy, particularly of mouthparts, and those details of structure which are used now to distinguish species, and the study of which has lifted systematic entomology out of the confusion in which it found itself when students first turned to medical entomology. The medical entomologists as much as any other group have given us better methods in systematic work. The volume is a credit to both author and printer.—C. H. K.

SIX NEW SPECIES OF APHIDS, WITH RECORDS OF OTHER SPECIES NEW TO CALIFORNIA.[1]

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For the past few years, the writer has collected aphids, where possible, in California. For a study of these, he has had access to two fairly large and representative collections of the aphid fauna of the state through the courtesy of Dr. E. O. Essig, of the University of California, and Dr. I. McCracken, of Stanford University, to whom he is also indebted for access to the literature of the subject.

This collection includes six species that are believed to be new, and thirteen species, collected by the writer and others, that are here recorded for the first time from California, as far as known to the author. The new species are herein described. The species *Callipterus elegans* Koch is also redescribed, for the reason that the original description (of 1854), which fits the species at hand very closely, is not readily accessible to students.

Callipterus elegans Koch. Redescribed.
(Figs. 1-6.)

Alate viviparous ♀.

Size and general color.—Length of body of 18 balsam specimens 1.6–2 mm. Color (alcoholic material), head and thorax buffy-cream to buffy-brown, lateral margins and median line brown, latter dilated centrally on both head and prothorax; a brown line from bases of antennae extending posteriorly to base of prothorax; thorax buffy, with brown pleural spot; abdomen (in life with pale greenish cast) with following dark brown markings: Segments 2–5 with large lateral patches, a patch surrounding base of cornicles, 3–6 with a pair of large dorsal patches which are usually separated, but sometimes joined in case of 5th segment, broken on 6th; on 7 and 8 are a variable number (2–6) of small dorsal spots, 7 and 1 also have small lateral spots. Eyes red. Antennae pale or straw color; I and II (with bases often pale), and tips of III-VI, and spur brown. Rostrum yellowish, extreme tip dark. Legs pale yellow; 2d and 3d coxae, 3d femora except base, bases of 3d tibiae, and all tarsi brownish. Wing veins luteous brown, costal and subcostal hyaline at base and basad of stigma for a distance about equal to length of stigma; latter brown, with central hyaline area reaching costal margin; 1st discoidal faintly smoky at base, with a

[1]Contribution from the Entomological Laboratory of Stanford University, California.

large squarish smoky apical patch, a side of which is about equal to length of anal fold; 2d discoidal faintly smoky at apex; 3d discoidal with broad smoky margin, whose width beyond the fork is nearly equal to width of stigma. Hind wings with oblique veins slightly smoky at base and apex (Fig. 1). Cornicles dark brown, cauda and anal plate lighter brown.

Head and appendages.—Width across eyes .47–.55 mm. Frontal margin of head angulate, due to two setae set on prominences and to notches for the insertion of antennae. Eyes large, occupying entire lateral margin of head. Ocelli prominent. Head with about 14 short transparent setae set in transparent circular spots (Fig. 5). Antennae (Fig. 6) reaching or passing cornicles; I, II short and bead-like, other joints elongate, imbricated except in sensorial region of III. Spur 2–3 times as long as broad. Length of joints, I, .06–.08 mm.; II, .06–.07 mm.; III, .53–.71 mm.; IV, .32–.415 mm.; V, .225–.32 mm.; VI base, .14–.17 mm.; spur, .05–.07 mm. III (Fig. 6) with 7–22 narrowly transverse secondary sensoria on basal one-half or three-fourths of joint. Primary sensorium on V small, its diameter one-half to one-fourth the width of the joint, from 1 to 4 times its diameter from end of the joint; primary sensorium on VI about twice as long as the one on V, with evident "haarkranz." Rostrum not reaching 2d coxae, apical joint longer than penultimate, the two united nearly as long as basal joint, clothed with hairs one-half as long as width of joints.

Thorax and appendages.—Thorax and prothorax with short hairs similar to those on head; thoracic lobes and scutum with a pattern of small circular lines which are not pore-like. Radial sector visible only with reduced illumination. Second discoidal bisinuate, 1st discoidal curving basad; curve from base of 3d discoidal to apex of its most anterior branch simulating the usual curve of the radial sector. Subcostal area with small transparent sensoria-like spots as follows: One about half way between stigma and base of 2d discoidal, from 2–6 in a cluster opposite origin of 2d discoidal, of which the one in line with the vein is the largest, and subequal in size to the one first mentioned, sometimes one near origin of 1st discoidal; the two larger transparent spots show 3 concentric circles with center dot, the others have but one or two circles. Hind wings with longitudinal vein dipping deeply to receive the origins of the oblique veins. Tibiae with 3 short apical spines which are twice as thick as the adjacent hairs. Second and 3d femora with 15–30 pale circular internal spots.

Abdomen.—(Fig. 2) Lateral dark patches centrally roughened, those anterior to cornicles somewhat tuberculate or even papillate, each with a seta set on a transparent, slightly knobbed base. Dorsal patches with similar setae, which on segments 3–6 are situated in oval areas with pale pore-like spots. These pore areas (Fig. 3) are very evident in some specimens, and invisible in others. Cornicles with a cone-like base, apex oblique, sides sinuate, with a prominent seta near the narrowest diameter; apical portion narrow, slightly longer than wide. Length .08–.10 mm. Cauda knobbed, with about 8 strong setae on the knob, length .115–.125 mm. Anal plate .09–.11 mm. long, depth of

emargination not less than one-half the length of the plate, broadly rounded, each lobe with about 8 hairs. At base of anal plate, in line with median notch are 2 small papillae, which may be equal in size, or one may be twice the thickness of the other, either or both may be slightly forked.

Apterous nymph, 4th instar.

Size and general color.—Body length of two specimens 1.1 mm. Color in life pale pea-green. Alcoholic material, pale straw color to light orange. Eyes red. Antennae pale yellow, extreme tips of III–V or apical half of V brown, VI entirely brown, or with base pale. Rostrum pale yellowish, extreme tip black. Cornicles pale, tip dusky. Legs pale, tarsi dusky. Abdomen yellowish, with brownish papillae bearing brownish hairs.

Head and appendages.—Head with 8 hairs (Fig. 4) which are inserted on prominent papillate bases, the tips of the hairs slightly expanded. I, II with about two short hairs each. Length of joints, I, .07 mm.; II, .055 mm.; III, .33 mm.; IV, .195 mm.; V, .16 mm.; VI base, .105 mm.; spur, .06 mm. Primary sensorium on V small, inconspicuous, distant from apex of joint about twice its diameter. Primary sensorium on VI elongate. If the spur is measured from the base of the sensorium instead of from its distal edge, the spur length is subequal to the base of VI. Imbrications faint on IV–VI. Rostrum thick, reaching 3d coxae, apical joint slightly longer than penultimate, the two united subequal to basal joint.

Thorax and appendages.—Tibiae thickly clothed with fine hairs; femora and tarsi with a few hairs. Prothorax with 6 (4 dorsal, 2 lateral) hairs similar to those on head and abdomen.

Abdomen.—With six rows of prominent hairs, which have expanded apices and are set on papillate or conical bases. Cornicles .09 mm. long, their sides slightly sinuate, but less than in alate viviparous ♀, the base also less flattened. Cauda broadly rounded, with about 10 short hairs. Anal plate not evident.

A small colony of this aphid was found on the tender shoots of elm, in Sacramento, Cal., on June 12, 1930. The aphids were feeding mostly on the under sides of the leaves, a few to each leaf. Slides 1008, A-H, in the author's and Stanford University collection.

The only reference to the species available is Koch's original description. His plate shows a smoky area on apical half of radial sector, which is wanting in the Sacramento specimens, otherwise, the description of Koch fits very closely.

This species is very close to *Myzocallis discolor* (Monell). *C. elegans* Koch has the antennae shorter than body, joints of flagellum brown-annulated, spur hardly half as long as VI base, III with 7–22 transverse sensoria, radial sector very faint, cornicles with seta, dorsal abdominal patches broader than

lateral patches, 2d and 3d femora with pale internal spots, and 2 median papillae at base of anal plate. *M. discolor* (Monell) has antennae longer than body, spur about twice as long as VI base, III with 2–4 circular sensoria, radial sector distinct, lateral abdominal patches larger than dorsal patches, no seta on cornicles, femora without internal pale spots, and no median papillae at base of anal plate.

The apterous forms may be readily recognized as follows: In *C. elegans* Koch, antennae shorter than body, annulated, spur shorter than base of VI, abdominal spines single. In *M. discolor* (Monell), antennae longer than body, without annulations, spur longer than base of VI, abdominal spines in pairs dorsally, mostly in threes laterally.

Aphis coronopifoliae new species.

(Plate I, Figs. 7–9.)

Alate viviparous ♀.

Size and general color.—Length of 9 balsam specimens, 1.70–2.15 mm. Head and prothorax deep olive green in life, in mounted specimens dark brown. Eyes black. Thorax blackish brown, with a green tinge. Abdomen green, with large olive brown lateral spots on 3–5, and one just behind each cornicle, dorsal spots on 3–5 small, a patch between cornicles, and bands on 7 and 8 smoky- to dark brown. Antennae deep luteous to dark olive, becoming lighter apically. Rostrum with apical half dusky. Coxae dark olive brown, 2d and 3d femora similar, with lighter base, 1st femora lighter brown, basal three-fourths of tibiae pale brown, apical fourth and tarsi dark brown. Wings hyaline, stigma grayish, veins yellowish. Cornicles, cauda and plates dusky.

Head and appendages.—Width of head across eyes .40–.52 mm. Antennae not reaching to base of cornicles. I wider than long, subequal to II. Length of joints, I, .06–.065 mm.; II, .06–.07 mm.; III, .27–.31 mm.; IV, .17–.21 mm.; V, .17–.185 mm.; VI base, .125–.15 mm.; spur, .17–.185 mm. Joints III–VI well imbricated. III with 11–17 small circular sensoria in about 2 rows, IV with 2–7. (Fig. 7). Primary sensoria on V and VI subequal, the one on VI with a cluster of 6 closely bunched accessory sensoria. Rostrum about reaching to 2d coxae, apical joint a half longer than penultimate, and two-thirds as thick, the two together about two-thirds as long as basal joint.

Thorax and appendages.—Wing spread 5.7–6.7 mm. Prothorax with a small lateral papilla on each side. Wing with subcostal sensoria-like spots 5–9, the spots uniform in size, with two concentric circles and central dot. Second fork of 3d discoidal regularly nearer wing apex than to 1st fork. Oblique veins of hind wing subparallel. Hamuli 3–5. All femora with internal pale spots. Tibial hairs about one-half as long as width of tibiae. Length of hind tarsi .11–.12 mm.

Abdomen.—Segments 1 and 7 with small lateral papillae. Derm with transverse dotted lines. Cornicles .125–.14 mm. long, sides parallel, apex squarely truncate, flange not conspicuous; imbricated from base to apex. (Fig. 8). Cauda .15–.17 mm. long, always longer than cornicles, tapering evenly from base to apex, central basal portion hyaline. Caudal hairs 4–6 (Fig. 9).

Apterous viviparous ♀.

Size and general color.—Body length of 4 balsam specimens 1.4–1.7 mm. Color green, antennae in mounted specimens brown, spur perceptibly lighter apically, tips of cornicles and tibiae, the tarsi, and femora distally darker. Apical half of rostrum dusky. Eyes reddish.

Head and appendages.—Width of head across eyes .37–.46 mm. Antennae not reaching to base of cornicles. Length of segments, 1, .07 mm.; II, .06–.065 mm.; III, .175–.24 mm.; IV, .13–.16 mm.; V, .13–.15 mm.; VI base, .11–.13 mm.; spur, .155–.18 mm. Secondary sensoria absent, primary sensorium on VI with a cluster of 6 accessory sensoria. Joints III–VI well imbricated. Antennal hairs short and few. Rostrum passing 2d coxae or almost reaching 3d coxae; apical joint slightly longer than penultimate, the two united subequal to basal joint.

Thorax and appendages.—Prothorax with a papilla on each side.

Abdomen.—Segments 1 and 7 each with a pair of lateral papillae. Cornicles cylindrical, slightly tapering, imbricated, length .145–.165 mm. Cauda always longer than cornicles, length .18 mm.; width at base .11–.115 mm.; with 2–3 pairs of lateral hairs, and one dorsoapical, base centrally hyaline, sides tapering evenly or slightly sinuate basad of center.

Described from 9 alate and 4 apterous viviparous ♀s taken on *Cotula coronopifolia* L. growing in San Francisquito Creek, Stanford University, Cal., on Jan. 25, 1930. Cotypes, slide numbers 1007 A and B, in the author's collection.

This species is referred to the genus *Aphis* for the present. It seems to be intermediate in character between *Aphis* and *Pergandeida*. The cauda in both alate and apterous viviparous ♀s shows little or no median constriction, and is longer than, and almost twice as thick, as the cornicles. The spur is short, being less than one-half longer than the base of VI.

Amphorophora ceanothi new species.

(Plate I, Figs. 10–13.)

Apterous viviparous ♀.

Size and general color.—Body length of 8 balsam specimens 2.00–2.50 mm. Color green. Eyes dark red. Antennae, I, II, and base of III green, rest olive luteous, apices of III and IV, and all of V and VI browner. Femora distally light brownish, tibiae apically and

tarsi deeper brown. Cornicles slightly olive toward apex, cauda and plates pale olive. Apical joint of rostrum brownish.

Head and appendages.—Width of head across eyes .48–.53 mm. Antennae twice or more than twice as long as body, situated on stout tubercles. (Fig. 13). I stout, about twice as long as broad, and strongly bent outward at middle. Length of joints, I, .18–.20 mm.; II, .10–.12 mm.; III, .84–.95 mm.; IV, .76–.95 mm.; V, .80–.87 mm.; VI base, .23–.28 mm.; spur 1.40–1.56 mm. III is usually longer than IV, and IV is usually longer than V, but there is considerable variation in the comparative lengths of the three segments. Joints III–VI finely imbricated. III with 0–3 small circular sensoria near base. (Fig. 10) Antennal hairs scattering and not more than half as long as width of joint. Rostrum passing the 2d coxae, hardly reaching the 3d coxae; basal joint longer than the two apical joints which are subequal in length.

Abdomen.—Sides of abdomen with small inconspicuous papillae on segments 1–5 and 7. Cornicles .72–.82 mm. long, very slender, tapering slightly from base to beyond middle, then widening moderately preapically; with a few apical cross lines, otherwise inconspicuously imbricated. (Fig. 11) Cauda .24–.29 mm. long, approximately one-third as long as cornicles, obtusely triangular, sides nearly straight, with three pairs of lateral hairs and one dorsoapical. (Fig. 12) Anal plate broadly rounded. Abdominal hairs short and fine.

Described from 8 apterous viviparous ♀s collected on *Ceanothus* sp., in Golden Gate Park, San Francisco, Cal., on March 22 and April 1, 1930. On September 12, 1931, the same bush had a few small apterae on the leaves. Also collected on *Ceanothus* sp., at Alpine Ranch, near Corte Madera Creek, west of the Stanford University campus, on June 12, 1931. Types in the author's and the Stanford University collection. Slides 1003 A-C.

In Mason's key, the above described species runs to *evansii* Theobald, from which it differs by its smaller size and by its very elongate antennae with joints III, IV, and V differing but little in length. From other species of the genus having the apices of the cornicles not reticulated, and III with not more than 3 sensoria, it may be known at once by the short cauda, which is one-third as long as the cornicles.

Macrosiphum echinocysti new species.

(Plate II, Figs. 14–16.)

Alate viviparous ♀.

Size and general color.—Length of body of 39 balsam specimens 2.50–3.30 mm. Color forest-green, head with yellowish tinge, thoracic lobes light brown, mesosternum brownish, median abdominal stripe

darker. Eyes dark red. Antennae with I, II, and base of III pea green, remainder luteous. Cornicles pea green, extreme tip darker. Cauda pale green. Rostrum pale, tip dusky. Femora distally brownish, tibiae luteous, their tips and tarsi dark. Wings hyaline.

Head and appendages.—Width of head across eyes .52–.60 mm. Antennae usually more than one-half longer than body, situated on tubercles whose inner angles are rounded. Depth of frontal furrow of 9 specimens .07–.10 mm., width of furrow at bottom .08–.105 mm., width of furrow at top .21–.225 mm., thickness of tubercle at base .17–.21 mm. Length of joints, I, .18 mm.; II, .11–.12 mm.; III, .88–1.12 mm.; IV, .63–.87 mm.; V, .63–.80 mm.; VI base, .14–.20 mm.; spur, 1.11–1.39 mm. I is obliquely quadrate, obtusely angled on inner side below middle, II cylindrical-tapering, apex squarely truncate. IV–VI imbricated, III faintly so toward apical end. III with 3–9 (in one specimen only 1) small circular sensoria in a row on basal two-fifths of joint. (Fig. 15). The diameter of the sensoria is scarcely one-fourth the width of the joint. Primary sensorium on VI with 6–8 accessory sensoria. Antennal hairs mostly as long as width of joint. Median ocellus at bottom of frontal furrow. Rostrum reaching 2d coxae, numerously setose, basal joint one-half longer than two apical joints united.

Thorax and appendages.—Femora with internal light spots near distal end. Tibiae densely setose, the setae as long as width of tibia. Wing spread 10.00–11.80 mm. Prothorax with a small papilla on each side. Stigma about 6 times as long as its greatest width. Hamuli 4–6.

Abdomen.—Cornicles 1.05–1.20 mm. long, only the rim darker; base broadened, tapering on basal third, then with sides parallel to near apex, which is distinctly but very slightly narrowed; well imbricated, apical fourth or a little less or more with reticulations. (Fig. 14) Cauda .35–.50 mm. long, base one-half as great as the length, sides tapering evenly to apex, without constriction; with 5–7 pairs of lateral hairs and one dorsoapical, hairs as long as, or longer than, width of cauda. (Fig. 16) Anal plate well rounded, with marginal hairs shorter than caudal hairs.

Apterous viviparous ♀.

Size and general color.—Body length of 8 balsam specimens, 2.40–3.50 mm. Color forest-green, with slight whitish bloom, head paler, median abdominal stripe darker green. Eyes dark red. Base of antennae green, remainder luteous or pale luteous, tips of III–V, and all of VI slightly brownish. Tip of rostrum brownish, cornicles shading to brownish at apex, cauda pale green. Legs green basally, tibiae light orange brown toward apex, tarsi dusky.

Head and appendages.—Width of head across eyes .54–.61 mm. Depth of frontal furrow .07–.10 mm., width of furrow at bottom .07–.08 mm., width of furrow at top .21–.245 mm., thickness of tubercle at base .18–.21 mm. Antennae longer than body by as much as one-half, characters much as in alate. III with 2–6 small circular sensoria near base. Length of joints, I, .16–.19 mm.; II, .10–.13 mm.; III, .78–1.03 mm.; IV, .56–.75 mm.; V, .55–.69 mm.; VI base, .16–.17 mm.; spur, 1.12–1.18 mm. Rostrum reaching nearly to 3d coxae.

Thorax and appendages.—Sides of prothorax, each with small papilla. Tibial hairs proportionately longer than in alate viviparous ♀.

Abdomen.—Cornicles .93–1.25 mm. long, apical one-fifth to one-sixth reticulated, cauda .45–.55 mm. long; other characters of cornicles and cauda as in alate viviparous ♀.

Described from 39 alate and 8 apterous viviparous ♀s, collected from *Echinocystis* sp. in Golden Gate Park, San Francisco, Cal., on May 4, 1930. The under sides of the leaves were tenanted by thousands of the aphids which dropped by hundreds with a light shaking of the vine. In 1931 the same vine was visited but no aphids were present. Types in the author's and the Stanford University collections. Slides 1006, A-T.

This species seems to be closely related to *Macrosiphum californicum* (Clarke), from which it may be separated by the following characters:

M. echinocysti new species. Cornicles slightly longer than III, at most one-eighth longer, with apical one-fourth to one-third reticulated. Cauda twice as long as width at base, with 11–15 hairs.

M. californicum (Clarke). Cornicles more slender and proportionately longer in relation to III than in preceding species, with about apical one-twelfth reticulated. Cauda narrower, base less than half as great as length, with three pairs of lateral hairs and 1–2 dorsoapical. Sensoria on III are more closely grouped, and the preapical narrowing of cornicles more evident than in preceding species. In general, *californicum* is more elongate and the wings are less ample than in *echinocysti*.

See also the discussion in this paper of the differences between *M. echinocysti* and *M. tenuicauda*.

Macrosiphum salviae new species.

(Plate II, Figs. 24–27.)

Alate viviparous ♀.

Size and general color.—Body length of one balsam specimen 2.15 mm. Color could not be determined, but seemed to be reddish brown; antennae, legs, and cauda not as dark as other parts of body. Wings hyaline, veins yellowish, stigma pale olive.

Head and appendages.—Width of head across eyes .50 mm. Antennae situated on prominent tubercles, one-half longer than body (Fig. 24). I is slightly angulate on inner side. Hairs scattering, some about as long as width of joint. Length of joints, I, .18 mm.; II, .09 mm.; III, .75 mm.; IV, .58 mm.; V, .48 mm.; VI base, .14 mm.; spur, 1.00 mm. III with 14–15 small circular sensoria in a row on inner

edge, none on apical fourth (Fig. 27). V and VI imbricated, IV faintly so, III not at all. Rostrum reaching hind edge of 2d coxae.

Thorax and appendages.—Wing spread 6.5 mm. Stigmal vein sharply bowed on basal half, nearly straight on apical half. First and second discoidals, and branches of third discoidal straight. Second fork of third discoidal nearer apex of wing than to first fork. Hamuli 2–3. Hind tarsi less than half as long as cauda.

Abdomen.—Cornicles .49 mm. long, rather robust, base broadened, apical fifth slightly tapering. Apical fifth to sixth reticulated, remainder imbricated. Apical flange distinct (Fig. 26). Cauda .27 mm. long, base broad, tapering to median constriction, then slender and with sides parallel to the end; with 3 pairs of lateral hairs, which are nearly twice as long as width of cauda at their insertion, and one dorsoapical (Fig. 25).

Apterous viviparous ♀.

Size and general color.—Length of body of 4 balsam specimens 2.00–2.50 mm. Color dark chestnut brown, head and prothoracic segment rufous, legs, antennae, cauda (less so than other parts), and cornicles black, coxae and bases of femora luteous.

Head and appendages.—Width of head across eyes .49–.54 mm. Antennae half longer than body, situated on smoothly rounded tubercles. Depth of frontal furrow .07–.08 mm.; distance between bases of 1st antennal joints .24 mm., thickness of tubercle at base .17 mm. Bottom of furrow plain, without median projection. Lengths of antennal joints, I, .17–.18 mm.; II, .09–.10 mm.; III, .76–.96 mm.; IV, .50–.64 mm.; V, .45–.56 mm.; VI base, .14–.16 mm.; spur, .90–1.00 mm. III with 2–4 small circular sensoria near base. Primary sensorium of VI with 6 accessory sensoria in 2 rows of 3 each. Antennal setae moderately numerous, about half as long as width of joint, and rather thick. Rostrum passing 2d coxae, basal joint subequal to the two apical joints, apical joint narrow and longer than penultimate joint.

Abdomen.—Cornicles .47–.58 mm. long; base widened, remainder parallel to apex or with apex slightly narrowed, flange not prominent; apical one-fifth to one-sixth reticulated, remainder imbricated. Cauda .27–.34 mm. long, similar to that of alate viviparous ♀. Anal plate broadly rounded.

Described from one alate and four apterous viviparous ♀s taken at Rancho Sante Fe, San Diego Co., Cal., on July 2, 1930. The host was *Salvia mellifera*. Type in the author's collection. Slide 1004.

This species seems to be intermediary between the true Macrosiphums and the Illinoia forms of the genus *Macrosiphum*. The cauda is typically that of the red species of *Macrosiphum* as far as form is concerned, but the small number of caudal hairs and the single row of sensoria on III are typical of Illinoia forms. The short, relatively heavy cornicles with narrowed apex differs from all other species of the genus studied.

Macrosiphum tenuicauda new species.

(Plate II, Figs. 21–23.)

Alate viviparous ♀.

Size and general color.—Body length of 29 balsam specimens 1.70–2.40 mm. Color probably green in life; antennae brownish, II and base of III paler, sensorial area of III darker than rest of joint, distal half of spur paler or not; femora little darkened distally, tarsi and tips of tibiae brownish. Tip of rostrum dusky. Cornicles and cauda concolor with body. Wings hyaline.

Head and appendages.—Width of head across eyes .48–.54 mm. Antennae about twice as long as body, situated on divergent tubercles. Depth of frontal furrow .07 mm., width at bottom .07–.09 mm., width across top .19–.21 mm.; thickness of tubercle at base .16 mm. Length of antennal joints, I, .15–.17 mm.; II, .08–.10 mm.; III, .76–.98 mm.; IV, .68–.80 mm.; V, .60–.73 mm.; VI base, .14–.18 mm.; spur, 1.16–1.36 mm. III with 5–13 circular sensoria in a row on basal two-thirds of joint (Fig. 21). Primary sensorium of VI with 6–8 closely grouped accessory sensoria. Rarely, there is a sensorium on the spur near the base. I is obliquely quadrate, with inner side gibbous below middle. III smooth, IV faintly, V and VI well imbricated. Antennal hairs mostly a little longer than width of joint. Rostrum reaching to hind edge of second coxae.

Thorax and appendages.—Wing spread 8.60–9.50 mm. Stigma 5–6 times as long as its greatest width, its apex acuminate. Second fork of third discoidal either nearer to first fork than to apex of wing or vice versa. Hamuli 2–4.

Abdomen.—Cornicles .93–1.10 mm. long, base slightly broadened; apically there is a slight narrowing, making the tip seem to be slightly broader; flange sharp; apical one-fifth to one-sixth with closed reticulations, rest imbricated (Fig. 22). Cauda .37–.45 mm. long, the base mostly one-third as wide as the length. Caudal hairs 4–5 pairs lateral, and 1–2 dorsoapical. Sides of cauda tapering evenly, not constricted (Fig. 23).

Apterous viviparous ♀.

Size and general color.—Length of body of 15 balsam specimens 1.75–2.60 mm. Color probably green in life; tips of III and IV narrowly, of V more broadly, and all of VI brownish. Tip of rostrum dusky. Tips of cornicles and tibiae, and the tarsi darker than the ground color.

Head and appendages.—Width of head across eyes .49–.54 mm. Antennae about twice as long as body, characters much as in alate viviparous ♀. Length of joints, I, .15–.18 mm.; II, .09–.10 mm.; III, .76–.94 mm.; IV, .55–.78 mm.; V, .53–.67 mm.; VI base, .14–.17 mm.; spur, 1.12–1.30 mm. III with 2–6 small circular sensoria near base. Rostrum passing 3d coxae.

Thorax and appendages.—Both femora and tibiae prominently setose.

Abdomen.—Cornicles .92–1.17 mm. long, cauda .38–.52 mm. long, both similar to the same parts in alate viviparous ♀.

Described from 14 slides, with 29 alate and 15 apterous, viviparous ♀s, in the Essig collection. Slides 1009, A-O. Collected on May 24, 1916, on *Urtica gracilis holosericea* Jepson, in Wild Cat Canyon, Contra Costa Co., Cal., by E. O. Essig.

The species is closely related to *Macrosiphum echinocysti* above described, from which it may be distinguished by the following table:

M. echinocysti—alate viviparous ♀ with 1–9 sensoria on III. In only 4 antennae from 39 specimens were there more than 7 sensoria. Body length 2.50–3.30, wing spread 10.00–11.80 mm. Hamuli 4–6. Reticulation of cornicles on apical one-third to one-fourth. Caudal hairs 11–15. Length of cauda two to two and a half times the width at base (in one specimen three times). Apterous viviparous ♀ distinguishable only by the broad cauda with 12–15 hairs.

M. tenuicauda—alate viviparous ♀ with 5–13 sensoria on III. In only 4 antennae of 29 specimens were there less than 8 sensoria. Body length 1.70–2.40, wing spread 8.60–9.50 mm. Hamuli 2–4. Cornicles with apical one-fifth to one-sixth reticulated. Caudal hairs 9–12. Length of cauda two and a half to three times the width at base. Apterous viviparous—with narrow cauda which has 9–12 hairs.

Macrosiphum aucubae new species.

(Plate II, Figs. 17-20.)

Alate viviparous ♀.

Size and general color.—Length of body of 20 balsam specimens 2.3–2.8 mm. Color: head olive drab, prothorax with pale olive cross bar, thoracic lobes ochre brown, abdomen pale pea green, shining, with small lateral spots on 3–5, and with olive green dorsal bands, broken on 1–3, complete on 4 and 5. Antennae olive brown at base, flagellum pale luteous, base of III broadly and apices of III–V very narrowly pale. Eyes red. Tip of rostrum brownish. Mesosternum olive brown, legs pale luteous, femora distally, tips of tibiae, and the tarsi blackish brown. Cornicles greenish to olive, tip broadly darker. Cauda pale green.

Head and appendages.—Width of head across eyes .51–.57 mm. Eyes rounded oval. Ocelli, lateral circular, median elongate. Antennae one-half longer than body, situated on broad tubercles. Width of frontal furrow at base, .13 mm.; at tip, .22 mm.; depth, .043 mm.; width of tubercle at base of I, .16 mm. Length of joints, I, .17–.20 mm.; II, .10–.12 mm.; III, .72–.96 mm.; IV, .70–.95 mm.; V, .59–.82 mm.; VI base, .19–.24 mm.; spur, 1.05–1.20 mm. III with 5–10 circular slightly projecting sensoria in a row along inner edge of joint (Fig. 18). Primary sensorium of VI with 5–6 accessory sensoria. The primary and secondary sensoria have an inner circular line. I is obliquely

quadrate, with a small gland-like area on inner side, II with sides tapering to the squarely truncate apex. I and II are prominently hyaline at the articulations. Antennal hairs fine, some about as long as width of joint, set on a papillate base. I is strongly imbricated on inner side, less so elsewhere, II evenly but finely imbricated, III usually smooth, sometimes faintly, IV faintly, V and VI well imbricated. Head with about 30 fine hairs set on papillate bases. Rostrum rather thick, passing 2d coxae, with hairs similar to those on head.

Thorax and appendages.—Wing spread 8.50–10.00 mm. Stigma much elongated, acuminate apically. First and second discoidals slightly smoky margined, radial vein evenly curved throughout. Branches of 3d discoidal meeting at an acuminate angle, 2d fork about midway between 1st fork and apex of wing. The hind wing of one specimen has a 3d oblique vein arising apicad of media and extending in a nearly straight line to near wing apex, its tip nearer to end of longitudinal vein than to end of media. Hamuli 2–4. Tibial hairs numerous, rather stout, and nearly as long as width of the joint. Femora distally with internal pale spots.

Abdomen.—With numerous fine, sharply pointed hairs arranged somewhat in horizontal rows. Spiracles situated at one side of oval less chitinized areas, with concentric lines about the openings. Prominent sublateral clusters of gland-like spots or pores on dorsum of 2–4, more or less extending across 5, and mediad to cornicles on 6. Cornicles .48–.70 mm. long, base broad, sides mostly parallel, or very slightly narrower toward apex, with truncate ends having flat, sharply flaring rims. Apex with a few closed reticulations, otherwise surface is faintly imbricated (Fig. 20). Cauda .23–.33 mm. long, tapering-triangular, apex rounded, with 3 pairs of curved lateral hairs, which are longer than width of cauda, and one dorsoapical (Fig. 19). Anal plate broad, rounded, with 2 rows of short hairs, genital plate broader than anal plate, with a marginal row of hairs.

Apterous viviparous ♀.

Size and general color.—Body length of 16 balsam specimens 1.80–2.90 mm. Uniformly pale pea green, shining. Eyes dark red. Tips of III–VI brownish, spur entirely pale or brownish. Apices of cornicles brown.

Head and appendages.—Width of head across eyes .50–.60 mm. Depth of frontal furrow .06–.075 mm., width at bottom .08–.095 mm., width at top .25–.26 mm.; thickness of tubercle at base .15–.18 mm. Antennae a little more than one-half longer than body, situated on broad divergent tubercles which are well curved on inner side and straight on outer side. Length of joints, I, .15–.20 mm.; II, .08–.12 mm.; III, .62–.94 mm.; IV, .56–.86 mm.; V, .50–.76 mm.; VI base, .17–.23 mm.; spur, .92–1.18 mm. III with 1–3 (rarely none) small circular sensoria near base. Primary sensorium on VI with a cluster of six accessory sensoria. Antennal hairs fine, sharply pointed, some as long as width of joint. All joints imbricated, I with an area of glandlike pores on inner side, as in alate viviparous ♀. Dorsal surface of head finely imbricated, the dots tending somewhat to be regularly arranged in lines. Rostrum extending to or passing 3d coxae.

Abdomen.—Spiracles as in alate viviparous ♀. Cornicles .44–.68 mm. long, base broadened, tapering to beyond middle, then sides parallel to the squarely truncate apex. A few reticulations at apex, remainder faintly imbricated. Cauda .20–.33 mm. long, with 3 pairs of curved lateral and one dorsoapical hairs. Base of cauda broad, tapering evenly to the rounded apex. Plates rounded, with marginal hairs. Body spines fine and short, rather scattering.

Described from numerous specimens taken from *Aucuba* sp. in the court at the Union, Stanford University, and in the Japanese tea garden in Golden Gate Park, San Francisco, Cal. Dates of collection from November 9 to June 3. Types in the author's and Stanford University collections. Slides 1005, A-H.

The species is placed in *Macrosiphum* on the basis of the divergent antennal tubercles, though the cornicles and cauda are more typical of *Myzus*. Its nearest relative seems to be *Macrosiphum pelargonii* Kalt., from which it differs by the smaller number of sensoria and caudal hairs, the slight shading of the 1st and 2d discoidals, and the presence of dark dorsal bands and lateral spots on the abdomen. In Frison and Hottes' key to the Illinois species of Macrosiphum, this species runs to *pallens* Frison and Hottes, which species has more sensoria on III, the cauda constricted at middle, primary sensorium on VI "apparently" without accessory sensoria, and in color is entirely pale yellow-green.

The gland-like areas on the abdomen and 1st antennal segments are unique structures in *Macrosiphum*, as far as known to the author.

The following species are here recorded from California for the first time, as far as determined by the author.

Cinara cupressi (Buckton)[1]. Collected from *Cupressus* sp., Palo Alto, Cal., May 10, 1930, a single alate; Carlsbad, Cal., July 5, 1930, a single apterous viviparous ♀. In the Stanford University collection are two slides of this species previously undetermined, the specimens being from Italian cypress, collected on the campus on October 3, 1916, by Doane and Ferris. Swain (Ent. News, vol. 32, p. 221) states that the only known records of this species are by Cholodkovsky, Buckton and Theobald.

Cinara curvipes (Patch).[1] In material loaned by Essig were 11 slides of an undetermined species which checks very well with

[1]This and the following species are attributed to *Cinara* Curtis, following Hottes, Proc. Biol. Soc. Wash., vol. 43, pp. 185–8, and Gillette and Palmer, Ann. Ent. Soc. Am., vol. 34, 1931, p. 843. They were formerly placed in *Lachnus*.

curvipes. The records are: On *Abies concolor*, Golden Gate Park, San Francisco, Cal., May 25, 1916; on *Abies pinsapo*, at Niles, Cal., July 28, 1916; on *Abies nobilis*, at Niles, Cal., May 8, 1916. Recorded elsewhere from Maine, Connecticut, Utah and Colorado.

Calaphis castaneoides Baker. Collected from *Castanea* at Fullerton, Cal., on August 9, 1930; at Pasadena, Cal., on September 27, 1930. The only other record of this species known to the author is that by Baker (Proc. Ent. Soc. Wash., vol. 18, p. 184).

Monellia costalis (Fitch). Collected from *Juglans* from following localities: Los Angeles, San Fernando, Puente, Whittier, Duarte, Santa Ana, San Gabriel, and Summerland, Cal. Dates of collection June 26 to November 20, 1930. Recorded elsewhere from Connecticut, New York, and Illinois. Taken on pecan at Sacramento, Cal., in 1931 by Haenggi.

Myzocallis robiniae (Gillette). Collected on *Robinia* from the following localities: Stanford University, San Rafael, Napa, Calistoga, Ukiah, Willits, Yreka, Susanville, Greenville, Quincy, Woodford's, Groveland and Palo Alto, Cal. Also taken at Newark by Dr. I. McCracken. Dates of collection April 15 to September 27, 1931. Elsewhere recorded from Colorado and Utah.

Clavigerus bicolor (Oestlund).[2] Collected on *Salix* in Golden Gate Park, San Francisco, Cal., on May 4, 1930. There is a slide in the Essig collection previously labeled *populea?*, which is this species; the record is from Berkeley, Cal., March 28, 1916. Also taken by H. Davidson at Sebastopol, Cal., June 2, 1927. Recorded elsewhere from Connecticut, Ohio, Minnesota, Nebraska and Colorado.

Aphis coreopsidis Thomas. Collected on *Bidens pilosa*, at Monrovia, Cal., on September 30, 1930. Recorded elsewhere from Connecticut, Ohio, Nebraska, Minnesota and Colorado.

Aphis laburni Kalt. Collected from *Cytisus* and *Spartium* from the following localities: Stanford University, Los Angeles, Carlsbad, Lemon Grove, San Diego, Santa Ana, Anaheim, San Fernando, Santa Maria, Sacramento and San Rafael, Cal. Dates of collection, February 9 to December 16. Elsewhere recorded from Connecticut, Illinois, Europe and Asia generally.

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[2]This species, formerly placed in *Melanoxantherium*, is here attributed to *Clavigerus* Szepligeti, following Gillette and Palmer, Ann. Ent. Soc. Am., Vol. 24, 1931, p. 93.

Macrosiphum schrankii Theobald. Collected at Stanford University, Cal., on *Erodium*, January 17 and 24, 1931. In Essig's undetermined material are several slides of this species taken by Bassinger at Mercy Springs, Cal., March 25, 1921. Elsewhere recorded from Europe in general, Argentina and Illinois.

Phorodon menthae (Buckton). Collected on *Mentha* at Stanford University, Cal., from April 1–30. Elsewhere known from England, Holland, Formosa, Nebraska. Thomas records the species from Illinois, but Davis doubts the record.

Myzus solani (Kalt.). Patch (Bull. 346, Me. Ag. Exp. Sta.) reports that specimens of this species collected on peas at San Jose, Cal., were sent to her in 1912. No other record from the state has come to the author's notice. In 1930 and 1931, collections were made at Stanford University, Berkeley, San Francisco, Palo Alto and Los Angeles, Cal. Dates of collection, November 9 to June 22. Host plants, *Geranium dissectum*, *Erodium*, *Stachys californica* and *S. ajugoides*, *Vinca*, *Lamium*, *Achillea*, *Acer negundo* var. *californicum*, *Stellaria*, *Ulmus*, *Asarum*, *Oxalis*, *Symphoricarpos*, *Rosa*, *Solanum*, *Convolvulus*, *Anthemis*, *Valeriana*, *Melilotus*, *Conium*, *Lathyrus*, *Rumex* and a grass of undetermined species.

Forda olivacea Rohwer. This species was previously collected by Mr. Homer Rowland, in San Francisco, Cal., from *Bromus* roots, from November 7 to May 1. His study of the species is in manuscript. The species also occurs at Stanford University on roots of *Hordeum* and *Avena*.

EXPLANATION OF PLATES.

PLATE I.

Figs. 1–6. *Callipterus elegans* Koch. Alate viviparous ♀, except as noted. Fig. 1, wings; Fig. 2, abdomen, dorsally; Fig. 3, pore-like area on abdomen; Fig. 4, spine of apterous nymph, 4th instar; Fig. 5, head; Fig. 6, antenna.

Figs. 7–9. *Aphis coronopifoliae* sp. n. Alate viviparous ♀. Fig. 7, antenna; Fig. 8, cornicle; Fig. 9, cauda.

Figs. 10–13. *Amphorophora ceanothi* sp. n. Apterous viviparous ♀. Fig. 10, antenna; Fig. 11, cornicle; Fig. 12, cauda; Fig. 13, head.

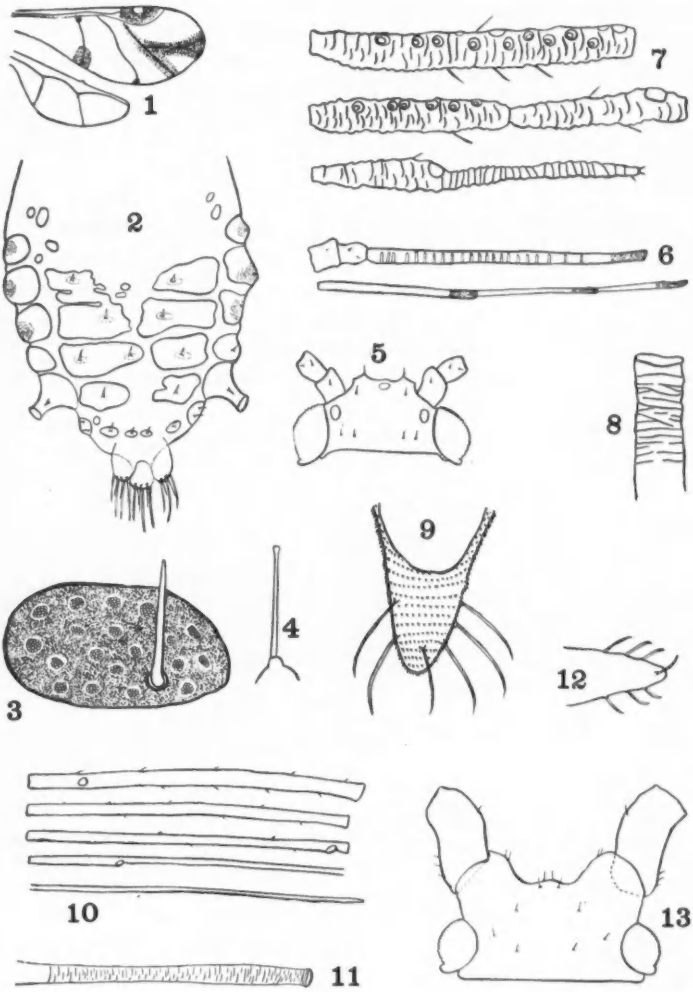
PLATE II.

Figs. 14–16. *Macrosiphum echinocysti* sp. n. Alate viviparous ♀. Fig. 14, cornicle; Fig. 15, antenna; Fig. 16, cauda.

Figs. 17–20. *Macrosiphum aucubae* sp. n. Alate viviparous ♀. Fig. 17, gland-like areas on abdomen; Fig. 18, antenna; Fig. 19, cauda; Fig. 20, cornicle.

Figs. 21–23. *Macrosiphum tenuicauda* sp. n. Alate viviparous ♀. Fig. 21, antenna; Fig. 22, cornicle; Fig. 23, cauda.

Figs. 24–27. *Macrosiphum salviae* sp. n. Alate viviparous ♀. Fig. 24, head; Fig. 25, cauda; Fig. 26, cornicle; Fig. 27, antenna.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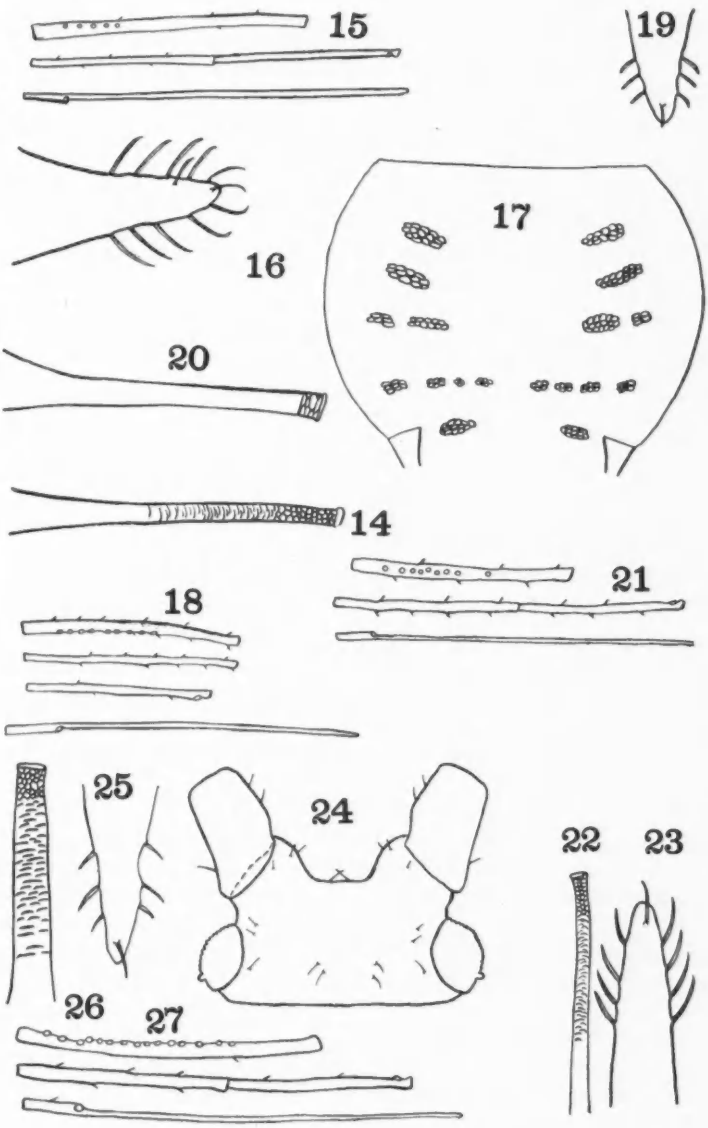
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THE IDENTITY OF THE BLACK PECAN APHID, MELANOCALLIS CARYAEFOLIAE (DAVIS).

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In 1910, J. J. Davis (2) described a "velvety black" aphid, collected from hickory in Illinois and Missouri, under the name *Callipterus caryaefoliae*, "the tuberculate hickory plant-louse." After examining the Fitch and Davis types, Baker (1) declared *caryaefoliae* to be a synonym of *fumipennella* Fitch which he placed in the genus *Myzocallis*. Subsequently a "black" aphid that has become abundant on pecan in the South was identified as *Myzocallis fumipennellus* (Fitch) and practically all references to the insect have been under that name. The common name, "black pecan aphid," has been adopted by the American Association of Economic Entomologists. In their recent work on the aphids of Illinois, Hottes and Frison (6) follow Baker's opinion as to the species but recognize the genus *Melanocallis* which was erected by Oestlund (7) for *caryaefoliae* Davis. They remark, "Fitch's original description, however, fails to agree in some respects with specimens we are calling this species." In order to identify the black pecan aphid with more certainty, the writer has studied the types of *fumipennella* and *caryaefoliae* in comparison with many additional specimens taken from pecan and other hickories. A report of these studies follows.

Aphis fumipennella Fitch.

Fitch (3) described five species of aphids which he took from the leaves of hickory. The most common was named *Aphis caryella*, and the four others were stated to be "similar to it in size, form and general color." All species were said to be yellow in color and to possess strongly depressed abdomens, wings that were laid flat upon the back, and cornicles that were mere pores. Among the four was *fumipennella* which Fitch (3) described thus:

"THE LITTLE SMOKY-WINGED APHIS (*A. fumipennella*) is of a dull yellow color with blackish feet and the wings smoky with robust brown

[1]In cooperation with the Georgia Agricultural Experiment Station.

veins, the rib-vein much more distant from the margin the first half of its length than in the other species, and from its middle to the stigma approaching the margin, the fourth vein long, equalling the stigma in length".

In his original notes Fitch (5) wrote further:

"The abdomen is remarkably short, in the 2 specimens—seeming to be contracted and shrivelled, with its segments indistinct. One specimen shows a small projecting tubercle at the anus, with a similar tubercle on each side of it—so that the species may perhaps pertain to the genus *Lachnus*, although the abdomen is so different from that genus. The other specimen exhibits no projections at the tip of the abdomen. A further examination of specimens that are not impaled, is desirable (July 8, 1852)". The specimens were "beat from walnut leaves, S base of Battle Hill, Salem, [Washington Co., N. Y.] July 8, 1852."

Later Fitch (4) transferred *fumipennella* and the related hickory aphids from the genus *Aphis* to *Callipterus* Koch.

The following description of *Aphis ? fumipennella* Fitch is drawn from the type, which consists of one aphid, a viviparous female, Fitch No. 1791. This was originally mounted on a card-point and years later was transferred to a slide by Theo. Pergande. Of the specimen there remains the head and prothorax, segments 1, 2, and 3 of the left antenna, and segments 4, 5, and 6 of a detached antenna, wings and legs in good shape, and a severely torn mesothorax and abdomen.

Aphis fumipennella Fitch, redescription.

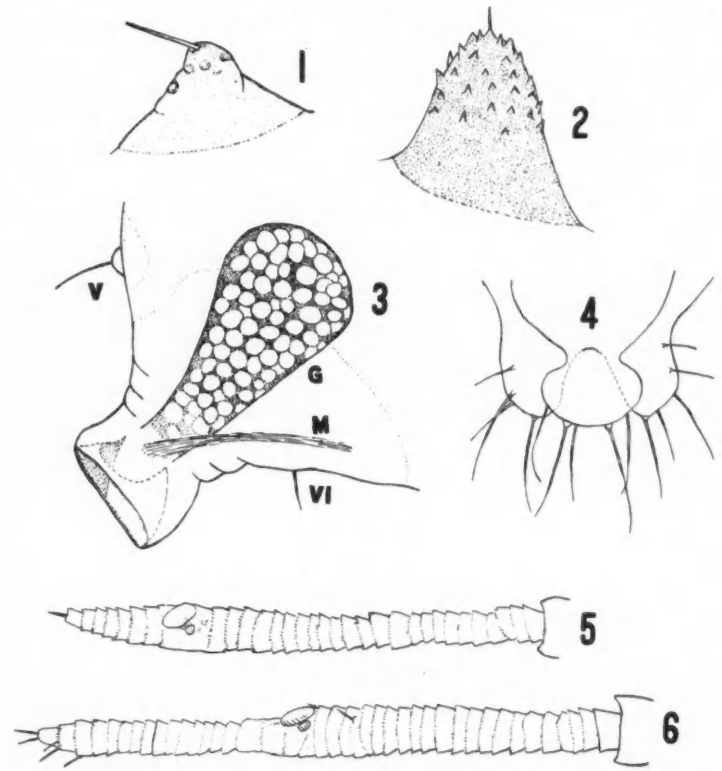
Head and prothorax with prominent paired tubercles, four pairs on the head back of the median ocellus and three pairs on the prothorax. The head has in addition one median tubercle posteriorly. There are two anterior and four posterior tubercles on the dorsum of the prothorax but none evident laterally. The tubercles (Fig. 1) are conical knobs with a warty surface and each bears a long terminal hair. The length of the prothoracic hair (0.027 mm.) is nearly equal in length to the height of the tubercle. Anterior and posterior tubercles of the prothorax equal in size, a little larger than the head tubercles.

On the broken abdomen can be found only two low tubercles with hairs, and three detached hairs 0.027 to 0.036 mm. long. There are also several hairs of embryos visible inside the adult, these hairs 0.062 to 0.071 mm. long.

Antennae: Segments I and II regularly cylindrical; III rather slender and bearing ten oval sensoria on the basal three-fourths, distal one-tenth dusky; IV, distal one-fourth dusky; V, distal one-third dusky, bearing one large sensorium near the distal end; VI with one large and several smaller sensoria, distal one-half darkened. Measurements in millimeters: I, 0.07 by 0.063; II, 0.063 by 0.047; III, 0.44;

IV, 0.24; V, 0.243; VI, 0.133 + 0.055. (Segment VI, sensoria included with unguis. Segment slightly inclined, total length about 0.20.) (Fig. 5).

Wing color uniformly pale smoky-brown. Fore wings with veins deep yellow, prominently marked throughout their courses except an



All figures were drawn with the aid of camera lucida. All parts were drawn from the respective types except Figure 3, which is a composite from several Georgia specimens collected by the writer.

Fig. 1. *Aphis fumipennella* Fitch. Anterior dorsal prothoracic tubercle (×400).
Fig. 2. *Melanocallis caryaefoliae* (Davis). Posterior dorsal prothoracic tubercle (×400).
Fig. 3. *Melanocallis caryaefoliae* (Davis). Cornicle. G—cornicle gland. M—valve muscle. V—lateral hair, abdominal segment 5. VI—lateral hair, abdominal segment 6 (×400).
Fig. 4. *Melanocallis caryaefoliae* (Davis). Cauda and anal plate (×211).
Fig. 5. *Aphis fumipennellae* Fitch. Terminal segment of antenna (×400).
Fig. 6. *Melanocallis caryaefoliae* (Davis). Terminal segment of antenna (×400).

interruption at base of media; subcosta approaching costa at stigma; cubitus bowed slightly toward wing base at middle; anal heavier than cubitus or media; stigma yellow at base and along the inner side with little color at the apex; radial sector entire, faint. Cells without marks. Hind wings also with prominent veins and clear cells.

Legs slender and uniformly yellow, the hind femur of normal thickness. Lengths of parts: femora, fore 0.35 mm., mid 0.30, hind 0.48; tibiae, 0.6, 0.6, 0.87.

The cornicles, cauda, and anal plate are not discernible.

So much for the Fitch species, *fumipennella*. Now to turn to Davis' hickory aphid.

Melanocallis caryaefoliae (Davis).

This species need not be described here but certain observations are made to supplement the work of Davis. A study was made of his type, U. S. N. M. No. 13443, and of several hundred mounted aphids of the species from Georgia. The type slide holds two viviparous females collected at Lake Forest, Ill., June 24, 1909.

Davis did not do justice in his figure to the tubercles of this aphid. The height of the dorsal tubercles on segment 2 of the abdomen is one-fifth to one-fourth of the vertical diameter of the abdomen and the mesothoracic are nearly as large. The latter compare well in size with the first and second antennal segments taken together. There are also numerous small tubercles on the head, and end of the abdomen, not noted by Davis. The surface of the tubercles (Fig. 2) is set with broad spines, irregularly placed, and on the apex of each tubercle is a sharp hair (length of hair on the posterior prothoracic tubercle, 0.009 mm.).

The number of secondary sensoria in 520 antennae from Georgia aphids was found to vary between 4 and 20, mean in summer aphids 7. The number is greater in the stem mother and spring generations than in later generations. The proportion of the length of the base of segment VI (Fig. 6) to that of the unguis (taking the base as ending at the proximal edge of the large sensorium) varies between 0.9 to 1 and 1.44 to 1, the mean being 1.1 to 1. That is, the base of segment VI is usually slightly greater in length than the unguis.

In the fore wing the anal cell and the proximal half of the costal cell are clouded, and in the hind wing there is a characteristic duskiness of the extreme distal end.

The hind femur is somewhat swollen. The lengths of the femora, fore, mid, and hind, are in the proportion 6:5:7.

The cornicles, cauda, and anal plate are illustrated in Figures 3 and 4.

DISCUSSION.

It is believed that Fitch accurately described *fumipennella* as to the body color and wing characters (except possibly the item "wings held flat") and that the aphid was comparable to *caryella* in "size, form, and general color." The "blackish feet" are not apparent. The wings are only slightly pigmented but those of *caryella* (as observed in type slides) are entirely without color in the cells. On the other hand it seems impossible that Fitch could have likened the brown or black *caryaefoliae* to the yellow *caryella*.

It is unfortunate that Fitch did not note the dorsal tubercles of *fumipennella* which far surpass those of *caryella*. The tubercles mentioned in the original notes doubtless refer to the cauda and divided anal plate. No species of aphid is known to the writer that typically bears six dorsal tubercles upon the prothorax though occasionally this number is found upon the hickory aphid *Monellia nigropunctata* Granovsky. On 195 specimens of *caryaefoliae* four was the unvarying number, two anterior and two posterior. It is these structures that must have induced Baker to synonymize *caryaefoliae* with *fumipennella* but the tubercles are very different in the two species. On the prothorax of *caryaefoliae* the posterior pair (Fig. 2) is considerably larger than the anterior but in the other species the tubercles are equal in size; the surface of the *caryaefoliae* tubercles bear many spines while the others are nearly smooth; the terminal hair of *fumipennella* is much the longer. The remnants of the abdominal tubercles of *fumipennella* do not compare at all with those of the black pecan aphid. As to the antennae, segments III of the two species are much alike but segments VI are quite different in proportion of base to unguis. The wings differ in color and shape of veins. The legs of *fumipennella* are different from those of *caryaefoliae*, particularly in color and in the shape of the hind femur.

This study shows the distinction of the two species. A comparison of the *caryaefoliae* type with a wide collection of aphids from hickory and pecan from several southern states has shown the black pecan aphid to be this species.

As to the genus in which *caryaefoliae* Davis should be placed: Oestlund erected for this species the genus *Melanocallis* (the black beauty) and though he poorly defined it, there is good reason for retaining the name. He gave three characters to distinguish *Melanocallis* from closely related genera: (1) found on leaves of hickory, (2) antennae longer than body, and (3) many spine-like tubercles on various parts of the body. The second character is in error, as the antennae of *caryaefoliae* are normally shorter than the body. The antennae of the two aphids of the type slide examined are 76 and 113 per cent as long as the respective bodies but in the second specimen, the abdomen is plainly much shrunken. Ninety-three aphids taken at Experiment, Ga., in two collections, April 29 and May 27, were measured under binoculars immediately after killing in alcohol, to ascertain the proportion of antennal length to body length. The length of the whole antenna varied between 65 and 110 per cent, the mean being 86 per cent, of the length of the body from front to caudal extermity. In only four aphids did the percentage exceed 100. As to the third character, "spiny" is a more accurate description of the tubercles than "spine-like." Hottes and Frison (6), through their keys, give certain valuable characters that are used in the following description:

GENUS MELANOCALLIS OESTLUND, 1923.

Type, *Callipterus caryaefoliae* Davis, 1910.

Head without antennal tubercles. Antennae of six segments, the unguis subequal to the base of VI. Cornicles truncate, constricted, length subequal to breadth. Cauda well knobbed. Anal plate deeply indented. Dorsum with greatly developed spiny tubercles, abdomen with large spiny lateral tubercles. Fore wings with media twice branched, hind wings with media and cubitus present. Legs developed for jumping.

Fumipennella is known only from the imperfect type specimen and can not now be placed in any genus. It undoubtedly belongs to the tribe Callipterini.

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MISCELLANEOUS DESCRIPTIONS AND NOTES ON PARASITIC HYMENOPTERA.

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Descriptions of eleven new species and one variety together with synonymical and distributional notes on several described species make up this paper. Species belonging to the families Braconidae, Chalcididae, Eurytomidae, Pteromalidae, Elasmidae, Eulophidae, Mymaridae, and Scelionidae are treated and these include representatives from Australia, Philippine Islands, Java, Mexico, United States, Cuba, Puerto Rico, St. Vincent, and Europe.

FAMILY BRACONIDAE.

Diaeretus oregmae, new species.

This species differs from *Diaeretus rapae* Curtis, as well as other species of the genus known to the writer, by having the antennae of the female 12-jointed and the joints of the flagellum unusually long, these being four or five times as long as broad. The ovipositor sheaths are unusually slender and slightly curved downward, resembling those of the genus *Trioxys*, but the abdomen is without the two curved processes at apex which constitute the main distinction between *Trioxys* and *Diaeretus*.

Female.—Length, 1.4 mm. Antennae as long as the insect, slender, 12-jointed; pedicel nearly as thick and about two-thirds as long as the scape; flagellar joints subequal, more slender than the pedicel, and each a little longer than the combined pedicel and scape. Head viewed from above as broad as the thorax at tegulae, about twice as broad as long; viewed from in front slightly broader than high; vertex and face very faintly sculptured, practically smooth; maxillary palpi short, 3-jointed; eyes nearly circular, distinctly hairy; ocelli forming an equilateral triangle, the postocellar line not over half as long as the ocellocular line; temples about half as broad as eyes, receding posteriorly; occipital carina delicate. Thorax ovoid; mesoscutum, scutellum, and mesopleura smooth, shining, parapsidal grooves effaced dorsally; scutellum small, nearly circular, margined laterally and apically by a delicate carina; propodeum declivous, distinctly areolated, with a very short median carina at base connecting with a very distinct and rather large four-sided diamond-shaped petiolar area, the costulae distinct and complete and forming with the marginal carina a large circum-

scribed area, on each side of the petiolar area; integument of propodeum practically smooth. Wing stigma rather short and broad; radius reaching about three-fourths of the distance to wing apex; metacarpus a little shorter than radius; basal vein well developed; medius, submedius, discoideus, and brachius indistinct, nearly effaced, the submedial and first brachial cells very poorly defined; other veins and cells absent; surface of wings including the basal cell rather closely ciliated; legs rather slender, the tibial spurs very short. Abdomen distinctly longer than the head and thorax, usually a little narrower than the thorax, practically smooth; first tergite very slender, distinctly a little narrower at apex than at base, tapering gradually from base to apex, about four times as long as broad at the middle, polished; second tergite triangular, smooth; following tergites collapsed, apparently smooth; ovipositor sheaths very slender, about two-thirds as long as hind basitarsus, curved slightly downward.

General color brownish-black or dark fuscous; scape, pedicel, first flagellar joint, and more or less of the second pale yellowish, rest of flagellum fuscous; vertex, frons, and temples dark fuscous; face, clypeus, cheeks, mandibles except apically, palpi, prothorax, legs including all coxae, and the first tergite beneath pale yellowish; mesoscutum and scutellum blackish or dark fuscous; mesopleura, metapleura, and propodeum lighter fuscous or brownish; abdomen dark brownish above, paler fuscous beneath; wings subhyaline, the veins and stigma fuscous.

Male unknown.

Type Locality.—Island of Panay, Philippines.

Type.—Cat. No. 43433, U. S. N. M.

Described from six female specimens (one holotype) said to have been taken ovipositing in *Oregma lanigera* Zehntner on sugar cane on the Island of Panay by A. W. Lopez.

Apanteles leucostigmus (Ashmead).

Fifteen specimens reared from *Eudamus proteus* Linnaeus at Santiago de las Vegas, Cuba, were recently received and identified by the writer. The species is now known to occur in St. Vincent, Puerto Rico, and Cuba.

FAMILY CHALCIDIDAE.

Antrocephalus stokesi (Crawford). (New combination).

Haltichella stokesi Crawford, Proc. U. S. Nat. Mus., vol. 41, 1911, p. 271.
Antrocephalus pomonellae Cameron, Proc. Linn. Soc. N. S. W., vol. 37, pt. 1, 1912, p. 200; Girault, Mem. Queensland Mus., vol. 3, 1915, p. 346 (new synonymy).

In the opinion of the writer, *Haltichella stokesi* Crawford and *Antrocephalus pomonellae* Cameron, both of which were described as parasites of *Carpocapsa pomonella* from New South Wales, are the same species. The types of *stokesi* are in the National collection and have been compared with Cameron's description

and also with specimens identified by A. A. Girault as *pomonellae* Cameron, the latter specimens reared from the codling moth in 1931 at Eastwood, New South Wales, by R. W. Burrell. Cameron pointed out the similarity in color of his species to that of Crawford, but since Crawford had placed his species in *Haltichella*, a genus with which Cameron's species did not agree, the latter concluded his species must be different. The types of *stokesi*, however, do not belong to *Haltichella*, since they have the hind femora finely serrated beneath, the frontal depression margined laterally by carinae which meet above the anterior ocellus, and the scutellum distinctly bidentate at apex. These characters as well as all others agree with the genus *Antrocephalus* and it is there that the species should be placed.

The species is somewhat variable in size and also in the color of the legs. Females examined ranged in length from 5.20 mm. to 3.40 mm. In two females, one of which is the holotype of *stokesi*, the legs, excepting the front coxae and the tarsal claws, are a clear red. In another female, however, only the middle and hind coxae, the hind femora, and the anterior and middle tarsi are clear red, the anterior and middle femora and tibiae and the hind tibiae and tarsi being piceous black with the apices of tibiae somewhat reddish. The legs of one male are considerably darker than those of the male type of *stokesi*, being entirely black except that the basal three-fourths of the hind femora are red.

FAMILY EURYTOMIDAE.

Eurytoma tylodermatis Ashmead.

Eurytoma tylodermatis Ashmead, Trans. Amer. Ent. Soc., vol. 23, 1896, p. 218.
Bruchophagus herrerae Ashmead, Psyche, vol. 9, 1902, p. 324 (new synonymy).

The type of *Bruchophagus herrerae*, a female from Coahuila, Mexico, reared from *Anthonomus grandis* Boheman, has been compared with the type of *Eurytoma tylodermatis* and, in the opinion of the writer, is the same species.

FAMILY PTEROMALIDAE.

Amblymerus verditer (Norton). (New combination).

Pteromalus verditer Norton, Trans. Amer. Ent. Soc., vol. 2, 1869, p. 327.
Nasonia tortricis Brues, Can. Ent., vol. 42, 1910, p. 259 (new synonymy).

In the opinion of the writer, *Pteromalus verditer* Norton and *Nasonia tortricis* Brues are the same species and belong in the genus *Amblymerus* Walker.

Pteromalus verditer was described from specimens reared from (*Lophyrus*) *Neodiprion abietis* (Harris) in Connecticut. In the United States National Museum collection are two females believed to be a part of the original type material. They agree with the description and bear the label "*Pteromalus verditer* Norton," perhaps in Norton's handwriting; also a small handwritten label "type." With these supposed types are two females reared from the larva of *Diprion simile* (Hartig), August 2, 1916, at New Haven, Connecticut, by M. P. Zappe; also one female reared from *Neodiprion abietis* at Glenboro, Manitoba, by R. D. Bird, August 3, 1926. The last mentioned specimen was identified by the writer, while the two from *D. simile* may have been named by J. C. Crawford.

Nasonia tortricis was described from specimens reared from (*Tortrix*) *Harmologa fumiferana* (Clemens), the spruce budworm, at Baskatong, Quebec. The type of this species has not been seen, but through the courtesy of Dr. C. T. Brues a broken paratype specimen has been examined. Eighteen females in the National collection, originally identified as *Nasonia tortricis* by J. C. Crawford and which were reared from the spruce budworm, August 9, 1912, at Pittsbury, New Hampshire, under Hopkins U. S. No. 11100b[2], have also been studied. These appear to the writer to be correctly identified. More recently the Bureau of Entomology has received from A. H. MacAndrews several specimens, reared from this same host at Westree, Ontario, August 15, 1928, which are without doubt the same species as the paratype and those named by Crawford.

A study of all the above-mentioned material shows no apparent differences between the parasite from the sawflies and that from the moth and, as already stated, I therefore believe *verditer* and *tortricis* are the same species.

The species bears very little resemblance to the genotype of *Nasonia* (which genus is a synonym of *Mormoniella* Ashmead).[1] It is excluded from *Mormoniella* (=*Nasonia*) at once by the wholly immargined occiput, by the quite differently shaped head, and by the fact that the antennae have three ring-joints instead of two. It conforms very closely to the characters of the genus *Amblymerus* Walker as represented by *Amblymerus amoenus* Walker, the types of which were seen and studied by the writer on the occasion of a visit to the British Museum.

[1]Gahan. Proc. U. S. Nat. Mus., vol. 71, Art. 4, p. 5.

FAMILY ELASMIDAE.

Elasmus maculatus Howard.

This species, previously reported from St. Vincent and Puerto Rico, occurs also in Cuba as shown by specimens received by the writer from S. C. Bruner, Santiago de las Vegas, reared as a secondary parasite of *Eudamus proteus* Linnaeus through *Apanteles leucostigmus* Ashmead.

Elasmus zehntneri Ferriere.

Elasmus zehntneri Ferriere, Bull. Ent. Research, vol. 20, 1930, p. 417.

Specimens reared by W. D. Pierce from *Topeutis intacta* Snellen at San Isidro, Occidental Negros, P. I., have been identified as this species by the writer. Mr. A. W. Lopez has also sent specimens of the species from La Carlota, Occidental Negros, reared by him from the same host, in August, 1930.

FAMILY APHELINIDAE.

Genus **Tumidiscapus** Girault.

The three known species of this genus may be distinguished by the following key:

1. Females 2
   Males 4
2. Ovipositor extending beyond apex of abdomen a distance slightly less than the length of hind basitarsus; third funicle joint as broad as long; length of body including ovipositor, 0.8 to 1.0 mm.; color nearly uniformly pale testaceous ..... **flavus** Girault
   Ovipositor extending beyond apex of abdomen a distance distinctly greater than the length of hind basitarsus; third funicle joint longer than broad; length of body including ovipositor more than 1 mm.; color not uniformly pale testaceous 3
3. Ovipositor extending beyond apex of abdomen a distance equal to first and second joints of hind tarsus combined, not nearly half as long as abdomen; general color fusco-testaceous, the abdomen usually somewhat darker than thorax; length of body including ovipositor about 1.5 mm ..... **orchelimumis,** new species
   Ovipositor extending beyond apex of abdomen a distance equal to first four joints of hind tarsus, nearly or quite half as long as abdomen; general color yellow, the abdomen scarcely darker than the thorax; length of body including ovipositor about 1.5 mm ..... **orthopterae** Gahan
4. Scape very broad, subquadrate, and uniformly testaceous ..... **orthopterae** Gahan
   Scape oval or elliptical, distinctly longer than broad 5
5. Scape uniformly testaceous; body nearly uniformly testaceous; wings hyaline ..... **flavus** Girault
   Scape with a blackish or dark fuscous area on lower apical margin; body fusco-testaceous; wings with a distinct fuscous tinge **orchelimumis,** new species

Tumidiscapus orchelimumis, new species.

Tumidiscapus flavus Metcalf and Colby, Jour. Econ. Ent., vol. 23, 1930, p. 108 (not *flavus* Girault).

Female.—Length, including ovipositor, 1.5 mm.; length of forewing, 1.1 mm.; greatest width of forewing, 0.37 mm. General color fusco-testaceous, the head and thorax usually less strongly tinged with fuscous than the abdomen which is always fuscous laterally and sometimes mostly brownish; antennae fuscous and the legs very slightly infuscated; wings subhyaline with a very faint fuscous tinge.

Antennae 6-jointed; space nearly cylindrical; pedicel twice or a little more than twice as long as broad when viewed from the side; funicle 3-jointed; first joint about one and one-half times as long as broad, obliquely truncate at apex, the dorsal margin shorter than the ventral; second funicle joint nearly as long as pedicel, two and one-half to three times as long as broad; third funicle joint about one and one-half times as long as broad; club solid, about as long as the funicle and no thicker than the third funicle joint, its apex acute and slightly curved. Head transverse, the fronto-vertex granularly sculptured, rest of head apparently nearly smooth; eyes with very short inconspicuous pile; malar space rather long. Mesoscutum and scutellum slightly shining, with very fine shallow (almost granular) sculpture; parapsidal grooves deeply impressed; median groove on mesoscutum and scutellum very delicate; scutellum about as broad as long, with four setae; propodeum collapsed on either side of the middle leaving a sharp median ridge. Legs slender, the front tarsi distinctly longer than their tibiae, hind tarsi shorter than their tibiae. Forewings about three times as long as broad; marginal and submarginal veins nearly equal; stigmal short, very oblique; postmarginal absent; base of wing bare to apex of submarginal, beyond rather closely and finely ciliated but with a distinct hairless streak extending postero-proximad from the stigmal vein nearly to the posterior margin; longest marginal cilia approximately one-seventh as long as the greatest width of wing; hind wing with two rows of discal cilia along the anterior margin from apex of venation to apex of wing, the anterior row close to the margin and somewhat confused with the marginal fringe, remainder of discal ciliation about as in forewing; marginal cilia of hind wing not quite as long as breadth of wing. Abdomen conical, as broad as thorax at base and narrowing gradually to apex, approximately one and one-fourth times as long as head and thorax, the ovipositor sheaths extending beyond apex of abdomen a distance about equal to the length of first and second joints of hind tarsi combined.

Male.—Length, 0.9 mm.; length of forewing, 0.87 mm. Antennal scape broadly oval, about one-third longer than broad, compressed, with a large blackish area on the lower apical margin, the outer side of scape distinctly rugulose or reticulated; funicle somewhat shorter than in the female, its third joint not longer than broad, the second not over twice as long as broad. Abdomen not longer than the head and thorax, elliptical. Otherwise about as in the female.

Type Locality.—Anna, Illinois.

Type.—Cat. No. 43921, U. S. N. M.

Described from ten females and two males reared from eggs of *Orchelimum vulgare* Harris by C. L. Metcalf, April, 1929. The female holotype and five female paratypes are mounted on slides, the remaining specimens, including allotype, on card points.

This series of specimens was originally identified by the writer as *Tumidiscapus flavus* Girault for Metcalf and Colby, who published the record under that name in connection with the above-cited paper on the host insect. A reexamination of this material, the writer is sorry to say, shows it to represent apparently a different species, very similar to *flavus* but separable by the characters given in the foregoing key.

Four additional specimens reared from eggs of an unknown orthopteron at Carlisle, Pa., by E. J. Udine, January 29, 1931, and recorded in the U. S. Bureau of Entomology under Carlisle Laboratory Cage No. 7426, have been identified as this species but are not considered a part of the type material.

Prospaltella tristis (Zehntner).

Prospalta tristis Zehntner, Mededе. van het Proefstation Oost-Java, n. s. No. 29, 1896, pp. 11–12, pl., figs. 17–21.

Prospaltella tristis Mercet, Trab. del Mus. de Cien. Nat. de Madrid, No. 10, 1912, p. 215.

Aspidiotiphagus aleyrodis Ashmead, Proc. U. S. Nat. Mus., vol. 38, 1904, p. 139 (new synonymy).

Specimens reared from *Aleurodes bergi* Signoret on sugar cane at Passoeroean, Java, and believed to be a part of the original Zehntner material of *P. tristis* have been compared with the types of *Aspidiotiphagus aleyrodis* Ashmead which were reared from an aleyrodid on sugar cane at Manila, Philippine Islands. The two lots appear to the writer to be specifically identical.

A large number of specimens reared from an aleyrodid on sugar cane at Silay, Occidental Negros, P. I., by A. W. Lopez have been recently studied by the writer and identified as this species.

FAMILY EULOPHIDAE.

Tetrastichus oecanthivorus, new name.

Tetrastichus (*Geniocerus*) *dispar* Silvestri, Bol. Lab. Zool. Agri. Portici, vol. 14, 1920, p. 249 (not *T. dispar* Masi).

The *Tetrastichus dispar* described by Masi from the Seychelles Islands (Nov. Zool., vol. 24, 1917, p. 221) is evidently a different species from *Tetrastichus* (*Geniocerus*) *dispar* Silvestri, and the latter name is therefore a homonym regardless of whether *Geniocerus* is considered a good subgenus or a synonym of *Tetrastichus*. The specific name *oecanthivorus* is therefore proposed to replace *dispar* Silvestri.

The species is said to be parasitic in the eggs of *Oecanthus* in Italy and it is fully described and the parts figured in the above-cited publication.

Tetrastichus oecanthivorus variety **compar,** new variety.

Eleven specimens of a *Tetrastichus* reared from eggs of *Oecanthus* species collected at Carlisle, and Mount Holly Springs, Pa., by C. C. Hill and J. S. Pinckney were recently received through the Bureau of Entomology. These were found to agree almost exactly with the description of *Tetrastichus* (*Geniocerus*) *dispar* Silvestri =*oecanthivorus* Gahan (see above), and specimens of both sexes were sent to Dr. Silvestri at Portici, Italy, for comparison with the types. Dr. Silvestri made the comparison and in a letter reported that the only differences he was able to discover were a slight difference in size and the fact that the male scape of the American form is twice as long as broad, while in the Italian form it is less than twice as long as broad. He suggested that if these differences were constant the American form should be considered a new variety of *dispar* Silvestri.

In the series of specimens at hand there seems to be little or no variation with respect to the characters mentioned and accordingly the American form is given a varietal name as suggested. The writer is inclined to the opinion, however, that the acquisition of additional material may demonstrate that the two forms are inseparable.

Female.—Length, 1.8 mm. Shining metallic green; the scape, apical half or more of pedicel, all femora and tibiae, the first segment of the abdomen above and below except narrow lateral margins, and

more or less of the second segment pale yellowish or stramineous; the antennal flagellum black or brownish-black; all tarsi dark brown; wings hyaline, the venation pale.

Male.—Length, 1.45 mm. Metallic green; head for the most part, prepectus, tegulae, front and middle coxae, all femora, all tibiae, first segment of abdomen, and base of the second segment pale yellowish testaceous; tarsi brownish; scape and pedicel brownish testaceous, the flagellum darker; wings hyaline. In some specimens the vertex is black or blackish.

The mesoscutum in both sexes is without a median groove, the parapsidal grooves and the two longitudinal furrows on the scutellum very distinct; propodeum with a slight median carina; sculpture of mesoscutum and scutellum very fine and shallow, of propodeum subobsolete. Other characters are as described and figured by Silvestri for *T. dispar.*

Type Localities.—Carlisle and Mt. Holly Springs, Pa.

Type.—Cat. No. 43916, U. S. N. M.

Described from eleven specimens (6 females and 5 males) reared from eggs of *Oecanthus* species by C. C. Hill and J. S. Pinckney. One male paratype and one female paratype are retained by Dr. Silvestri.

Tetrastichus pallidocinctus, new species.

Female.—Length, 0.92 mm. Aeneous black with a faint greenish tinge on head and thorax; the scape and pedicel pale testaceous; flagellum brownish testaceous; legs, including all coxae, white or very pale yellowish, the hind coxae more or less infuscated at base; basal one-third of abdomen pale above and beneath, the apical two-thirds black; wings hyaline, the venation pale.

Antennae weakly clavate; scape slender, a little longer than pedicel and first funicle joint combined; pedicel about twice as long as thick; funicle joints subequal or decreasing very slightly in length and increasing very slightly in thickness from first to third, the first as long or very nearly as long as the pedicel; ring-joints very minute; club 3-jointed, distinctly a little thicker than the third funicle joint and about as long as the second and third funicle joints together, the apical club joint conical and very small. Head a little broader than the thorax, weakly sculptured, eyes indistinctly hairy, malar space a little shorter than half the eye-height. Thorax with weak lineolate sculpture, the praescutum without a median groove and with no large punctures along the parapsidal grooves; scutellum with the two parallel grooves complete but very delicate; propodeum weakly shagreened, without median carina or lateral folds, the middle portion elevated into a slight ridge. Basal joint of anterior tarsus distinctly shorter than the second joint; middle and hind basitarsi very slightly shorter than the following joint. Forewing a little more than twice as long as broad; marginal and submarginal veins equal, the marginal about two and one-half

times as long as stigmal; submarginal with two erect bristles dorsally. Abdomen about as long as thorax, about twice as long as broad, not conical; ovipositor not exserted.

Male.—Length, 0.75 mm. Antennae about the same length as in female but not distinctly thickened toward apex, the scape thickened, about twice as long as broad, as long as the pedicel and two basal flagellar joints; funicle 4-jointed, the first joint shorter than the pedicel, subquadrate, second a little longer than the first but shorter than the pedicel, third and fourth each about like the second; club a little longer than the two preceding joints, 3-jointed, the apical joint conical and terminating in a short thick spine. Otherwise like the female except that the abdomen is smaller and more flattened.

Type Localities.—Jaronu and Portugalete, Cuba.

Type.—Cat. No. 43917, U. S. N. M.

Described from nine females and one male said to have been reared from pupae of a lepidopterous leaf miner in sugar cane by L. C. Scaramuzza under Tropical Plant Research Foundation Nos. 3874 and 3875. The host is being described as a new genus new species of Elachistidae by August Busck.

Tetrastichus oncideridis, new species.

Female.—Length, 1.8 mm. Nearly uniformly dark reddish-brown but with oral region, knees, apices of all tibiae narrowly, all tarsi, very narrow band at base of abdomen, and the last tergite yellowish; wings hyaline; antennae concolorous with the body. Head transverse, very weakly sculptured; antennae rather long, the three funicle joints subequal and each about twice as long as broad; club very slightly broader than the funicle and approximately as long as the two preceding joints together. Pronotum, mesoscutum, and scutellum with very fine shallow reticulation; praescutum about as broad anteriorly as long down the middle, with a distinct median longitudinal groove; scutellum slightly convex, about as broad as long, the two longitudinal grooves very distinct and rather close together, the sclerite between the grooves about as broad as the lateral sclerites; propodeum very short medially, without carinae and practically smooth although apparently with some very faint reticulations. Forewing more than twice as long as broad, the marginal vein slender, much longer than the submarginal and fully four times as long as the moderately long stigmal; postmarginal absent; the submarginal bears about four or five erect but not very large setae. Legs normal. Abdomen conic ovate, narrower than the thorax and about twice as long as the thorax, the ovipositor exserted a little more than the length of the last tergite.

Male.—Length, 1.6 mm. Black, more or less shining; antennae dark brown; a spot or line in front of ocelli sometimes yellowish; a narrow line on either side of mesoscutum bordering the anterior projection of the axillae also yellowish; trochanters, tibiae except a variable band beyond the middle, and tarsi pale yellow; wings hyaline. Antennae

longer than in the female, the funicle 4-jointed, the first funicle joint as broad as long, following three joints subequal and each about twice as long as broad, the funicle joints each furnished with a whorl of long hairs; club slightly longer than the two preceding joints together, not broader than funicle, 3-jointed, the joints each with long hairs similar to those of the funicle, the apical joint conical and terminating in a spine; sculpture of head and thorax as in the female. Abdomen not longer than thorax, and much narrower, the sides nearly parallel. Otherwise like the female.

Type Locality.—French Creek, W. Va.

Type.—Cat. No. 43918, U. S. N. M.

Described from five females (one type) and three males (one allotype) said to have been reared from *Oncideres cingulata* Say by F. E. Brooks under Quaintance Nos. 24323, 24327, 24328, 24329, and 24332.

Thripoctenus vinctus, new species.

Very similar to *T. brui* Vuillet but slightly smaller, with the second funicle joint globose, the wings somewhat narrower, and the abdomen mostly blackish with the base pale.

Female.—Length, 0.75 mm.; length of forewing in type, 0.50 mm., width of forewing in type, 0.16 mm. Head and thorax black and shining, apparently without sculpture; antennae and legs pale yellow, the middle and hind coxae infuscated, at least basally; wings hyaline; abdomen usually pale basally with the apical two-thirds blackish or fuscous. Head viewed from above transverse, about twice as broad as long, somewhat broader than thorax at tegulae; frons and vertex with numerous setae; eyes sparsely but distinctly hairy; antennal scape slender; pedicel ovate, thicker than either scape or funicle and nearly twice as long as thick; ring-joint very minute; first funicle joint slightly longer than broad, second nearly globose; club ovate, acuminate, about as thick as pedicel and about as long as the pedicel and first funicle joint combined, with one more or less distinct cross furrow at or a little before the middle, the joints otherwise fused; the two funicle joints with numerous moderately long hairs which are arranged in an apical and a basal whorl on each joint. Thorax nearly twice as long as broad; pronotum short, mostly concealed from above, the posterior margin with a row of setae; mesoscutum about one and one-half times as broad as long, the parapsidal grooves not sharply impressed, the praescutum with four setae and the scapulae with one each; axillae small, widely separated, and each with one weak seta; scutellum slightly broader than long and bearing a single pair of long setae; propodeum smooth, without carinae. Forewings rather small but extending beyond the apex of abdomen; the marginal vein much longer than submarginal; stigmal subsessile and about twice as long as the short postmarginal; submarginal vein with two long setae dorsally and one ventrally;

marginal vein with about seven long setae; surface of wing bare behind the submarginal vein, except for a single bristle near base of marginal vein, and with an extension of this bare area along the posterior margin reaching to a point about opposite the middle of marginal vein, this area limited anteriorly by a very distinct row of cilia which originates at the base of marginal and extends distally in a broad curve to the posterior margin of wing, the surface distad of this line closely and nearly uniformly ciliated; longest marginal cilia equal to nearly half the wing width; hind wing rather narrow, the longest marginal cilia much longer than the greatest wing breadth; discal cilia sparse especially so in the apex of wing where there is only a single row around the margin. Legs normal, the basal joint of each tarsus a little shorter than the apical joint. Abdomen ovate, about equal in length to head and thorax and as broad as the head, with a petiole which is a little broader than long; tergites apparently smooth, each with a transverse row of hairs before the apex, the row on second and third tergites interrupted at middle; ovipositor originating near middle of abdomen, ovipositor sheaths short and barely extended beyond apex of abdomen.

Male unknown.

Type Locality.—Laguna, Luzon, Philippine Islands.

Type.—Cat. No. 43919, U. S. N. M.

Described from eight female specimens received from D. T. Fullaway, and said to have been reared by Miss Irene Dobroscky from *Taeniothrips longistylus* Karny; also three females collected on the laboratory window at the College of Agriculture, Laguna.

Thripoctenus femoratus, new species.

Agrees with *T. vinctus* except that the forewings are longer and broader, the antennal club appears somewhat shorter, the abdomen is nearly uniformly blackish, and all of the coxae and femora are blackish. In the dark femora and coxae it differs from all of the described species except *nubilipennis* Williams and it differs at once from that species by the hyaline wings and pale tibiae as well as in the arrangement of the discal cilia on forewing and in antennal characters.

Female.—Length, 1 mm. Length of forewing, 0.60 mm., breadth of forewing, 0.23 mm. Black; antennae, trochanters, all tibiae and tarsi pale; all coxae and femora and the abdomen uniformly black or blackish; wings hyaline, the venation fuscous. Head and thorax apparently smooth and polished throughout. Antennal club ovate, barely longer than the two funicle joints combined, rounded at apex but with a short apical spine; funicle joints subequal, the second subglobose; forewing broader than in *vinctus*, without a seta on ventral side of submarginal in the type but with two on the dorsal side; the row of discal cilia running from base of marginal vein distally and

caudad to posterior margin of wing only slightly curved, nearly straight; longest marginal cilia of the hind wing shorter than the greatest width of wing; hind tibial spur conspicuous, about as long as basitarsus and slightly thickened. In other characters it agrees with the description of *vinctus*.

Male unknown.

Type Locality.—Laguna, Luzon, Philippine Islands.

Type.—Cat. No. 43920, U. S. N. M.

Described from one female specimen received from D. T. Fullaway and said to have been collected on bean flowers infested with *Taeniothrips longistylus* Karny. The type of this species is from the same locality and occurred along with *T. vinctus*. It may possibly be merely a variety of that species.

Chrysocharis pallipes (Gahan). (New combination).

Derostenus pallipes Gahan, Proc. U. S. Nat. Mus., vol. 53, 1917, p. 214.

This species is strictly congeneric with the following new species and is more properly placed in the genus *Chrysocharis*. The antennae are 10-jointed, consisting of scape, pedicel, three ring-joints, three funicle joints, and a 2-jointed club, the apical club joint terminating in a thick spine which is nearly as long as the joint itself. The first two ring-joints are very thin and lamellate, the third as broad as the base of first funicle joint, about twice as broad as long and structurally similar to the funicle joints, with a few long hairs and several sensory pores. This could more properly be considered a short funicle joint. In some other species of the genus it is more reduced but in all of the species represented in the National Museum collection it is obviously larger than the two true ring-joints, and bears a few sensory pores and hairs. The true funicle joints are all longer than broad, the first about twice as long as broad, the second and third a little shorter. The abdominal petiole is transverse and inconspicuous.

Chrysocharis cubensis, new species.

Very similar to *C. pallipes* (Gahan) but with distinctly finer and shallower reticulate sculpture and apparently with the malar space longer.

Female.—Length, 1 to 1.4 mm. Head, thorax, abdomen, and coxae bright shining green with coppery tints: front of head below the transverse groove strongly copper-colored; scape pale beneath, with a dorsal line and the apex fuscous, rest of antenna brownish-black;

eyes and ocelli reddish; legs except coxae white; tegulae pale; wings hyaline, with the venation dark brown; abdomen concolorous with the head and thorax. Head as broad as thorax; eyes large, conspicuously hairy; malar space about equal to the width of mandible at base; occiput finely sculptured; vertex nearly smooth, triangle below front ocellus and above the transverse groove as also the sides of frons below the groove rather strongly and finely punctate; bottom of antennal grooves smooth, the face and triangular raised area between antennae very weakly sculptured. Antennae very slightly thickened toward apex, 10-jointed; scape of nearly the same thickness throughout its whole length, about four times as long as broad; pedicel very little longer than broad; ring-joints three, the first and second very small, the third as broad as the funicle joint, about two and one-half times as broad as long and bearing several hairs similar to those on the funicle joints; funicle 3-jointed, the first not quite twice as long as broad, second a trifle shorter than first, third about one and one-half times as long as broad; club 2-jointed, very slightly thicker than the last funicle joint, the first a little longer and broader than the last funicle joint, apical joint conical and terminating in a spine or process which is about half as long as the body of the joint. Thorax about twice as long as broad; prothorax short, mostly concealed from above, weakly shagreened; mesoscutum shining, with nearly uniform weak reticulation, the parapsidal grooves represented by broad deep impressions extending the whole length of dorsum; scutellum nearly as long as mesoscutum, subconvex, very finely sculptured, the sculpture similar to that of the mesoscutum but a little finer and weaker, with a single pair of long pale setae a little behind the middle; propodeum smooth, without carinae or folds between the spiracles but with a distinct groove laterad of the spiracle. Legs with all tarsi shorter than their tibiae, the hind basitarsus not longer than the following joint, the hind coxae with its outer face very faintly sculptured. Wings about twice as broad as long, broadest very near the apex which is subtruncate; submarginal vein with two erect setae proximad of the break; marginal vein twice as long as submarginal; postmarginal twice as long as stigmal. Abdomen as long as thorax and about as broad, ovate, very weakly sculptured except base which is smooth; petiole short, transverse, apparently smooth, with an apical depression which is membranous and pale; ovipositor not exserted.

Male.—Length, 0.90 mm. Antennal scape distinctly but not greatly thickened, and somewhat darker than in the female; abdomen a little shorter than the thorax, metallic green at base and apex with the medial tergites bronzy-black. Otherwise like the female.

Type Localities.—Baragua and Jaronu, Cuba.

Type.—Cat. No. 43922, U. S. N. M.

Female holotype and one female paratype reared from an unidentified leaf miner in sugar cane at Baragua, by C. F. Stahl, in February, 1928, under Tropical Plant Research Foundation No. 3410; one female paratype reared by W. C. Loftin from the

same leaf miner at Baragua, July 21, 1930, under T. P. R. F. No. 5076; male allotype, one male paratype, and three female paratypes from sugar cane leaf miner at Jaronu, by L. C. Scaramuzza, July 14, 1930, under T. P. R. F. No. 3876; and three female paratypes reared from a lepidopteron which August Busck is describing as a new genus and new species of *Elachistidae* mining leaves of sugar cane at Santiago de las Vegas, Cuba, September 9, 1931, by Angel R. Otero under No. 9633a. It is probable that the host was the same species in each case.

Grotiusomyia nigricans (Howard).

Miotropis nigricans Howard, Jour. Linn. Soc. London Zool., vol. 25, 1894, p. 106.
Grotiusomyia nigricans Girault, Ent. News, vol. 29, 1918, p. 126.

Described originally by Howard from specimens collected in St. Vincent, West Indies, this species was subsequently recorded by Girault as having been reared from *Eudamus proteus* Linnaeus in the same island by F. Watts. The writer has identified as this species nine specimens from St. Vincent, reared from the lima bean leaf folder (*E. proteus*) by J. C. Hutson.

More recently three specimens of the same species were received from S. C. Bruner, of the Estacion Experimental Agronomica, Santiago de las Vegas, Cuba, with the statement that this species is apparently the most important parasite in Cuba of the lima bean leaf-tier, (*Lamprosema*) *Hedylepta indicata* Fabricius, and still more recently specimens were received through the Bureau of Plant Quarantine and Control Administration, collected at Rio Pedros, Puerto Rico, and said to have been reared from the same moth.

Pleurotropis Foerster.

Pseudacrias Girault, Arch. f. Naturg., Jahrg. 79, Abt. A, H. 6, 1913, p. 104 (new synonymy).

The genotype species of *Pseudacrias* (*P. micans* Girault) has not been seen by the writer, but in the National Museum collection are types of three species described by Girault in that genus and apparently agreeing with his generic description. All three of these species (viz., *P. carinatiscutum* Girault, *P. secundum* Girault, and *P. sexdentatus* Girault), in the opinion of the writer, belong in the genus *Pleurotropis*. Girault's description of the genus *Pseudacrias* offers no characters which will separate it from *Pleurotropis*, and the writer considers it to be a synonym.

Pleurotropis benefica Gahan.

Three specimens of *Pleurotropis* (a male and two females) reared February 17–25, 1930, from *Cephus pygmaeus*, collected in the vicinity of Cambridge, England, were recently received from W. R. Thompson, of the Farnham House Laboratory, Farnham Royal, Bucks, England. These specimens had been tentatively identified as *Pleurotropis benefica* Gahan by Dr. Ch. Ferriere, of the Imperial Bureau of Entomology, and were sent to the writer for verification of the determination. A comparison of them with the types of *P. benefica* leaves no room for doubt that the determination is correct.

Pleurotropis benefica was described from specimens reared by W. R. McConnell, C. C. Hill, and P. R. Myers, at Mount Holly Springs and Carlisle, Pennsylvania, from *Trachelus tabidus* Fabricius. The fact of its occurrence in Europe is very interesting and at once suggests the thought that it may be going under some other name there. *Pleurotropis nitifrons* Thomson (=*nitidifrons* of authors) is recorded in literature as a parasite of *Cephus infuscatus* in Europe by R. Forsius (Med. Soc. Faun. Flor. Fenn., 1915, p. 138) and a specimen reared by Forsius from *C. infuscatus* at Parna is in the U. S. National Museum collection, determined by J. C. Crawford as *P. nitifrons*. This specimen is extremely similar to *P. benefica*, but differs in that the middle and hind tarsi, except for the apical joint of each, are pale and the first funicle is scarcely longer than the second. All of the American specimens of *benefica* as well as those from England (twenty-one specimens in all) have the tarsi all black or very dark fuscous and the first funicle joint is much longer than the second. If Crawford's determination of *P. nitifrons* is correct (as it seems to me to be), then *P. benefica* and *P. nitifrons* are apparently not the same.

Again, the description of *P. nigritarsis* Thomson is extremely suggestive of *P. benefica* Gahan. This species is represented in the U. S. National Museum collection by one male reared from *Euplexia lucipara* Linnaeus by R. Forsius at Karislojo and determined by Crawford. This male has a much more slender flagellum than have males of *benefica*. The four funicle joints and the club are subequal in length, each about three times as long as thick, the first funicle joint not longer than the second, and the scape extends some distance above the front ocellus. In males of *benefica* the first funicle joint is distinctly longer

than the second, the second, third, and fourth joints are never more than twice as long as thick, and the scape does not extend beyond the front ocellus. It appears quite certain that the parasite of *Euplexia* and the types of *benefica* are different species.

Pleurotropis olethreutidis, new species.

Very similar to *sexdentatus* Girault but may be distinguished by the fact that the mesoscutum and scutellum are more weakly sculptured, the propodeum is perfectly smooth instead of very weakly shagreened medially, and the anterior aspect of head is less strongly copper-colored than is generally the case with *sexdentatus*. I am unable to separate the two very satisfactorily and *cubensis* may prove to be merely a geographical variant.

Female.—Length, 1.25 mm. Greenish above, mostly black beneath; vertex and anterior aspect of head with strong brassy tints; dorsum of thorax and propodeum green with brassy tints; legs brownish black, their coxae more or less metallic, and the three basal joints of tarsi pale; wings hyaline, venation dark brown; abdomen mostly black but with the basal two-thirds of second tergite metallic green. Vertex and frons weakly reticulated, the sides of frons below the transverse groove a little more strongly sculptured; cheeks and face below antennae about like the vertex; eyes with short sparse pile. Antennae short; ring-joints minute; funicle 3-jointed, the joints shortly pedunculate and of equal width; first funicle joint distinctly thicker than the pedicel and about as long as pedicel, about as long as broad; second and third joints a little broader than long; club 2-jointed, a little broader than the funicle joints, the first joint quadrate, the second conical and terminating in a spine which is nearly half as long as the body of the segment. Pronotum with the posterior dorsal portion short, smooth, and separated from the anterior declivous portion by a delicate transverse carina; mesoscutum more than twice as broad as long, weakly sculptured, the parapsidal grooves very delicate anteriorly and each terminating posteriorly in a shallow depression, the depressions sculptured like the rest of mesoscutum; scutellum very slightly longer than the mesoscutum, weakly reticulately sculptured, the reticulation a little more distant than that of mesoscutum; propodeum smooth and polished, with two delicate longitudinal carinae near the middle, the elevated median part of propodeum also carinately margined laterally and apically, the two areas thus inclosed each subquadrate. Forewing broadly rounded at apex, marginal vein longer than submarginal (about 11:14), stigmal short and subequal to the postmarginal; two erect bristles on the submarginal vein. Legs normal, the hind coxae wholly polished. Abdomen short ovate, very little longer than the thorax, nearly as broad as long; the petiole short, transverse, finely and closely punctate; second tergite broader at apex than long down

the middle, about equal in length to all of the following tergites combined, smooth basally with the apical one-third weakly shagreened as are all of the following tergites; ovipositor not exserted.

Type Locality.—Jaronu, Cuba.

Type.—Cat. No. 43923, U. S. N. M.

Described from twelve females reared from the pupa of an unidentified species of Olethreutidae infesting *Crotalaria* species, June 23, 1930, by L. C. Scaramuzza and received from the Tropical Plant Research Foundation under their No. 3840.

Horismenus eudami (Girault).

Pseudomphale eudami Girault, Ent. News, vol. 29, 1918, p. 130.

The original description of this species records it as a parasite of the larva of *Eudamus proteus* Linnaeus in the island of St. Vincent. The writer has recently received eleven specimens of the species reared in Cuba by S. C. Bruner from cocoons of *Apanteles leucostigmus* Ashmead which were in turn parasitic upon *E. proteus*. In all probability the specimens upon which the original description was based were also secondarily parasitic, as it is not believed probable that this species is both primary and secondary.

Cirrospilus ingenuus, new species.

Differs from all other species of the genus known to the writer by the uniform orange-yellow color.

Female.—Length, 1.25 to 1.40 mm. Pale orange-yellow, without any metallic markings; the antennal flagellum, a small transverse spot on occiput adjacent to point of attachment of head to prothorax, a transverse very narrow band on extreme anterior margin of pronotum at neck, a more or less definite transverse band basally on each of the second, third, fourth, and fifth dorsal tergites, and the exposed part of ovipositor sheaths brown to dark brown; wings hyaline, venation brownish-yellow; legs very slightly paler yellow than the thorax. Antennae inserted near the middle of head; funicle 2-jointed; the first funicle joint distinctly longer than the pedicel and longer than the second joint, about two and one-half times as long as thick; the second funicle joint about one and one-half times as long as thick; club very little thicker than the funicle and about equal to the funicle in length, 3-jointed, the joints not distinctly separated. Vertex faintly reticulated, rest of head nearly smooth. Pronotum, mesoscutum, scutellum, and propodeum very finely, almost granularly, sculptured; parapsidal grooves complete; scutellum with two very delicate grooved lines and with two pairs of setae; propodeum with a delicate median carina but without lateral folds. Forewing about two and one-half times as long as broad; the marginal vein much longer than submarginal and four

or more times as long as postmarginal; stigmal and postmarginal subequal. Legs slender; hind coxae sculptured on outer side. Abdomen about as long as head and thorax, as broad as thorax, pointed ovate, its surface very faintly sculptured except base of first tergite; ovipositor sheaths extending barely beyond apex of abdomen.

Male.—Length, 1.30 mm. Exactly similar to the female except that the abdomen is not longer than the thorax and is rounded at apex, and the brownish markings on head, pronotum, and abdomen are usually less distinct.

Type Locality.—Buitenzorg, Java.

Type.—Cat. No. 43924, U. S. N. M.

Described from two females and five males said to have been reared from *Phyllocnistis citrella* Stainton by Dr. A. Voute and received through the Institute for Plant Diseases of Java.

FAMILY MYMARIDAE.

Gonatoceros capitatus, new species.

A species very close to *G. brunneus* Girault, from which it may be distinguished, however, by the much paler vertex and frons, the perfectly hyaline wings, and by some very slight differences in the proportions of the antennal joints. The fifth funicle joint is slightly the longest funicle joint and the eighth funicle joint is distinctly shorter and a little narrower than the seventh in the female of the new species, while in *brunneus* the fifth joint is no longer than the seventh and the eighth is barely shorter and slightly thicker than the seventh joint. Also similar to *ornatus* Gahan, but differs in that the mesoscutum and scutellum are without white lines and the first four joints of the funicle in the female are equal or very nearly so.

Female.—Length, 0.70 mm. Sculpture not discernible in balsam mounted specimens; probably smooth. Antennae not as long as the body; radicle prominent, nearly half as long as the scape; scape, exclusive of the radicle, in lateral view straight dorsally, somewhat convex ventrally, about three times as long as broad; pedicel half as long as scape and twice as long as broad; first four funicle joints subequal, cylindrical, and each twice as long as broad; fifth funicle joint distinctly longer and thicker than the preceding joint and also longer and a little thicker than joint six; seventh funicle joint very nearly as long as joint five and distinctly a little longer and a little thicker than either the sixth or the eighth funicle joint, the eighth joint about one and one-half times as long as broad; club broader but less than twice as broad as the funicle, and very slightly longer than the three last funicle joints together.

Mesoscutum with the parapsidal grooves impressed; scutum and scutellum subequal in length; legs rather long and slender, the front pair with tarsi distinctly longer than their tibiae, the median and hind tarsi subequal in length to their tibiae; forewings long and rather broad, about three and one-half times as long as broad, without discal ciliation behind the venation; marginal cilia rather long but not equal to half the greatest wing width; marginal vein about six times as long as broad; hind wing narrow, the marginal cilia about three times as long as the breadth of wing. Abdomen about equal in length and breadth to the thorax, ovate, the ovipositor from origin to apex about equal in length to the hind tibia and not protruding beyond apex of abdomen. General color black, the vertex and frons brownish yellow and the abdominal sutures pale; antennae and legs black or brownish black, the tarsi pale; wings anteriorly hyaline.

Male.—Length, 0.70 mm. Antennae equal in length to the body; scape about twice as long as broad; pedicel about as long as broad; flagellar joints subequal in length and breadth, each about twice or a little more than twice as long as broad, the apical joints very slightly narrower than the basal ones. Otherwise like the female.

Type Locality.—Centerville, Utah.

Type.—Cat. No. 43941, U. S. N. M.

Described from ten specimens (4 females and 6 males) mounted on a single slide and said to have been reared from eggs of the beet leafhopper *Eutettix tenellus* Baker, August 28, 1928, by C. F. Henderson, at Centerville, Utah; two females and five males reared from eggs of the same leafhopper collected by C. F. Henderson at Santo Domingo, Lower California, Mexico; and one female reared from leafhopper eggs on red beets at Red Rock, Arizona, by Henderson.

Two additional specimens reared by Henderson from leafhopper eggs on *Atriplex* in July, 1928, at Nogales, Arizona, are believed to be this species but are not included in the type series because of certain differences in the female antennae, which are believed to be deformities. Five specimens reared by the same investigator from leafhopper eggs on Russian thistle at Nogales, Arizona, July, 1928, are very similar to *capitatus*, but are believed not to be the same.

FAMILY SCELIONIDAE.

Acoloides cubensis, new species.

This will run to *ochraceus* Ashmead in J. J. Kieffer's key (Das Tierreich, Scelionidae, vol. 48, 1916, p. 166) and also in Ashmead's key (Jour. Linn. Soc. Lond., vol. 25, 1894, p. 216).

It differs from the description of *ochraceus*, however, by having only the first and second tergites longitudinally striated, the eyes hairy, the third antennal joint nearly twice as long as thick, and the whole antennae nearly concolorous with the body. The type of *ochraceus* is in the British Museum, and the characters of the description have not been verified.

Female.—Length, 1.2 mm. Head, thorax, and abdomen uniformly brownish-yellow, the legs and antennae paler; wings very slightly fuscous. Antennae 7-jointed, situated at the clypeus; pedicel as long as three following joints together; first funicle joint about twice as long as broad, joints 2, 3, and 4 of the funicle as broad as long and moniliform; club large, nearly as long as funicle and pedicel together, and more than twice the width of pedicel. Head a little broader than thorax at tegulae, about three times as broad as long, viewed from in front a little broader than high; occiput perpendicular, forming with the vertex a sharp angle which is margined by a delicate carina; eyes short oval, distinctly hairy; lateral ocelli very near the eye margin and also close to occipital margin; frons, vertex, face, and cheeks with very fine granular sculpture, the frons immediately above the antennae slightly shining and with a delicate median carina extending from between the antennal bases a little more than half way to the front ocellus; malar groove distinct and nearly as long as the eye is high. Mesoscutum a little broader than long, without parapsidal grooves, and granularly sculptured like the head; scutellum broader at base than long, sculptured like the mesoscutum, and distinctly margined laterally and at apex; propodeum finely sculptured, with two parallel and very delicate longitudinal carinae near the middle. Wings fully developed, extending a little beyond apex of abdomen; marginal vein as broad as long; postmarginal absent; stigmal three or more times as long as marginal; discal ciliation nearly uniform and rather dense; marginal cilia moderately short; hind wing about half as broad as forewing, closely ciliated, and with the discal cilia equal in length to about half the width of wing. Legs not thickened, tibial spurs short. Abdomen as long as the head and thorax or a little longer, ovate, narrowed basally; first tergite longitudinally striated, about twice as broad as long; second tergite also striated except along lateral margins, its apex about twice as broad as apex of first; third tergite granularly sculptured, as broad as second, a little longer than the first and second combined, nearly quadrate, its sides nearly parallel; following tergites very short and sculptured like the third; ovipositor not visible.

Male unknown.

Type Locality.—Santiago de las Vegas, Cuba.

Type.—Cat. No. 43925, U. S. N. M.

Described from five female specimens received from Angel R. Otero, of the Estacion Experimental Agronomica, at Santiago de las Vegas, Cuba, and said to have been reared from the eggs of a spider belonging to the family Salticidae.

Telenomus podisi Ashmead.

Six specimens of this species have been reared at Santiago de las Vegas, Cuba, by S. C. Bruner from eggs of a pentatomid on lima bean. This is believed to be the first record of its occurrence in the West Indies.

Telenomus mesillae (Cockerell). (New combination).

Hadronotus mesillae Cockerell, Can. Ent., vol. 39, 1897, p. 25; Kieffer, Das Tierreich, Scelionidae, Lief. 48, 1926, p. 464.

Telenomus ashmeadi Morrill, Amer. Nat., vol. 41, 1907, p. 419, figs. 1b and 2 a and b; U. S. Dept. Agr. Bur. Ent. Bull. 64, pt. 1, 1907, p. 10, fig. 2 and pl. 1 (new synonymy).

The type of *Hadronotus mesillae* Cockerell, which is in the United States National Museum collection, is a male specimen reared from a hemipterous egg at Mesilla, New Mexico. It is not a *Hadronotus* but a *Telenomus*, and differs in no way from males of *T. ashmeadi* Morrill, the types of which were reared at Barstow, Texas, from eggs of *Pentatoma ligata* Say and *Thyanta custator* Fabr.

The species is a common parasite of pentatomid eggs in the southwestern states. Besides the above-mentioned type series, there are in the National collection specimens from Calexico, Calif., reared from eggs on cotton, V. V. Williams collector; Birds Landing, Calif., from eggs on wheat stubble, M. Marshall collector; and Maxwell, New Mexico, from eggs of *Pentatoma sayi* Stal, D. J. Caffrey collector.

THE PROBLEMS OF RELATIVE GROWTH, by JULIAN S. HUXLEY, pp. I–XX, 1–276, 104 text figures and graphs, 1931. Published by The Dial Press, Inc., New York.

This is a book which will interest those entomologists, usually of the younger generation, who are well trained in biological mathematics. The author has been able to define mathematically some of the simpler laws of the relative growth in the parts of the individual. His discussion of the overgrown jaws in male Lucanid beetles and the enormous heads in some soldier ants touch on two problems that have puzzled entomologists. For the first time we find what appears to be a sound explanation of "orthogenetic series" of species. The book also brings us nearer to a satisfactory analysis of the factors involved in the evolution of social castes in insect societies. There are seven chapters as follows: I, Constant Differential Growth-Ratios; II, The Coefficient of Constant Growth-Partition; III, Growth-Centres and Growth-Gradients; IV, Growth-Gradients and Distribution of Growth-Potential in the Animal Body; V, Growth-Centres and Growth-Gradients in Accretionary Growth; VI, Heterogony, Growth-Gradients and Physiology; VII, Bearings of the Study of Relative Growth on Other Branches of Biology. The concluding chapter has the following interesting subheads: 1, Heterogony and Taxonomy; 2, Heterogony in Groups Higher than Species; 3, Heterogony and Evolution; 4, Heterogony and Comparative Physiology; 5, Relative Growth and Genetics; 6, Relative Growth, Embryology and Recapitulation.—C. H. K.

THE GENUS ACANALONIA IN AMERICA NORTH OF MEXICO (Fulgoridae, Homoptera).

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The purpose of this paper is to give as nearly as possible a comprehensive systematic resume of the genus Acanalonia (Fulgoridae, Homoptera) in America, north of Mexico. Recent studies have included only the eastern and southeastern forms. This paper is an attempt at a comparative study of all previously described species. Descriptions of five new species are included in the text and a key to all North American forms has been devised.

From the discussion found in the three outstanding recent publications concerning the classification of the Fulgoridae, namely, those of Dozier[1], Muir[2], and Metcalf[3], it is apparent that the status of the family Fulgoridae as it stands in the literature at the present time is questionable. Muir makes the most radical departure of the three by dividing the Homoptera into two superfamilies, the Cicadoidea and the Fulgoroidea, and the latter then divided into numerous families of which twelve represent the more common subfamilies and genera listed for the United States. Metcalf, although agreeing that the old family Fulgoridae is too comprehensive, makes no departure from the commonly accepted view. Dozier seems to take a position somewhat between these two. Without a study of the complete group of the Fulgoridae the author prefers to follow Dozier's general classification, believing it to be logical and at the same time not too radical.

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[1]Dozier, Herbert. The Fulgoridae or Plant-hoppers of Mississippi, Including Those of Possible Occurrence. Miss. Agric. Exp. Sta. Bull. 14, 1926.

[2]Muir, F. On the Classification of the Fulgoroidea (Homoptera). Proc. Haw. Ent. Soc., V, No. 2, 1923.

[3]Metcalf, Z. P. A Key to the Fulgoridae of Eastern North America with Descriptions of New Species. Jour. Elisha Mitchell Sci. Soc., XXXVIII, 1923.

This classification is as follows:

Order Homoptera Latr.
Group I. *Auchenorhynchi* Amyot and Serville.
I. Superfamily Cicadoidea.
II. Superfamily Fulgoroidea.
Family I. Fulgoridae.
Subfamily 1. Fulgorinae.
2. Dictyophorinae.
3. Achilinae.
4. Cixiinae.
5. Tropiduchinae.
6. Issinae.
7. Acanaloniinae.
8. Flatinae.
9. Derbinae.
Family II. Delphacidae.
Group II. *Sternorhynchi* Amyot and Serville.

Superfamily FULGOROIDEA.

Antennae placed on the side of the head below the eyes, very variable in shape and size, usually of two segments terminated by a very fine hair or bristle, rarely with basal appendages (*Otiocerus*); sense organs on antennae numerous and generally of a complex nature and mostly situated on the second segment; middle coxae articulated considerably apart allowing for considerable range of movement, as opposed to those of Cicadoidea, which are closer together and allow for very limited movements; hind coxae immobile and exterior part coalesced with metathorax; no filter present between mid-intestine and crop; ovipositor with the exception of Delphacidae and part of Cixiinae greatly reduced or incomplete, anterior and middle pairs of valves not fastened together by tongue-and-groove arrangement as in the Cicadoidea. Prothorax normally developed and unarmed.

Family FULGORIDAE.

Separated from the Delphacidae by not having a movable spur at apex of hind tibiae. Other characteristics those of the superfamily.

Subfamily ACANALONIINAE (Amyot and Serville).

Elytra tectiform, held vertical with the costal margin meeting below the abdomen, closely reticulated over the whole surface; costa and apical margins without transverse veins; clavus not granulated, no spines on hind tibiae; front coalescent with vertex, usually without any transverse carina between them at apex of head.

COMPARATIVE NOTES.

This subfamily resembles the Flatinae and certain genera of the Issinae. It is separated from the Flatinae by having the elytra without cross-veins on the costal margin, not granulated on the clavus and spineless hind tibiae. It is separated from

the Issinae by having the elytra meeting below the abdomen, the front not usually separated from vertex by a transverse carina at apex of head, and by spineless hind tibiae.

Genus **Acanalonia** Spinola.

Head about as wide as thorax. Clypeus without lateral carinae. Vertex straight or somewhat angularly rounded anteriorly. Postclypeus flat, almost quadrangular, sometimes a longitudinal median carina and also two small lateral carinae present. Antennae short. Ocelli small. Pronotum usually without carinae, with sometimes a median carina. Posterior margin of pronotum straight or only slightly concave. Mesonotum large. Elytra steeply tectiform, reticulated with a network of veins, the longitudinal ones more prominent; elytra usually green in color with sometimes brown dots or lines at apex. Ovipositor incomplete. Oedagus complex, penis and periandrium appear to be amalgamated into a complete tube with appendages.

HISTORICAL REVIEW.

The subfamily contains only five or six genera of which only the genus *Acanalonia* is represented in the United States. Melichar[4] in 1902 monographed the family. In this group he included the following genera: *Amphiscepa*, *Acanalonia*, *Chlorochara*, *Batusa*, *Thiscia* and *Parathiscia*. Van Duzee (Catalogue, 1919) states that the true genus *Amphiscepa* Germar is an *Issid* genus and has for type *nodipennis* Germar, and of which *Issocepa* Melichar is a synonym. There has, according to him, never been a genus *Amphiscepa* Say as stated by Melichar. The genus *Chlorochara* according to Melichar occurs in Puerto Rico, the genus *Batusa* in Central America, Mexico and Puerto Rico, the genus *Thiscia* in South America and the genus *Parathiscia* in Africa. It is therefore quite probable that besides the genus *Acanalonia* the first two of the list may at some time be found in the United States.

Melichar (1902) lists seventeen species in the genus *Acanalonia* of which five are recognized North American species. He lists *bivittata* in the genus *Amphiscepa* Say. Van Duzee (Catalogue, 1919) lists nine species. Dozier (1926) lists five species from eastern United States and states that there are nine species in the United States. Metcalf (1923) in his key to Fulgoridae of the United States, keys out nine species. These nine species, however, do not coincide exactly with the

[4]Melichar, L. 1902. Monographie der Acanaloniiden and Flatiden (Homoptera).

nine listed by Van Duzee. He leaves out *A. mollicula* Van Duz. and *A. clypeata* Van Duz., two western species, and adds *virescens* Stal and *fasciata* Metcalf, a new species.

Considering the United States as a whole it brings the total number of species up to eleven. To this the writer is adding five new species, which makes it possible to have sixteen species occurring in North America north of Mexico.

The writer does not consider that *bivittata* should be placed in a separate genus from *Acanalonia* or that these fifteen species should be divided into two genera. There seems to be no constant character by which one can consistently group these species into two groups such as was used by Melichar when he stated, "head as wide as pronotum" or "frons nearly twice as broad as long." The wing venation apparently cannot be used as it differs considerably in the same species and even when apparent differences between the veins of two species can be followed they seem too slight for generic value.

KEY TO SPECIES OF ACANALONIA.

1. With a prominent median carina across vertex, pronotum, and mesonotum; large insects; length usually well over 9 mm. 2
   Without a prominent continuous median carina across head and thorax; length generally well under 9 mm. 3
2. (1) Length 9 to 12.5 mm.; costal margin of elytron broadly rounded. (Page 762) ..... **latifrons**
   (1) Length 14–15 mm.; costal border of elytron nearly straight posteriorly. (Page 764) ..... **servillei**
3. (1) Color uniform but with two prominent broad brown stripes on the lateral margins of vertex and thorax which extend along the inner margins to the apex of the clavus 4
   (1) Color uniform with only occasional fuscous shadings along inner margin or small fuscous dashes on apical margin; no brown stripes present 5
4. (3) Reticulation lacking at base of elytra; smaller in size, length varying from 4.2 to 6.2 mm. (Page 765) ..... **fasciata**
   (3) Reticulation prominent over all the elytra; generally much larger, length varying from 5.23 to 8.4 mm. (Page 766) ..... **bivittata**
5. (3) Vertex conically or broadly triangularly produced beyond eyes, *grandicella* sometimes excepted 6
   (3) Vertex truncate or broadly rounded in front, generally not greatly produced beyond eyes 10
6. (5) Vertex greatly produced conically. (Page 768) ..... **conica**
   (5) Vertex not greatly produced conically, at most triangular before 7
7. (6) Postclypeus large and tumid 8
   (6) Postclypeus normal, not large and tumid 9
8. (7) Elytra broadest anterior to middle, narrowed apically; vertex distinctly triangularly produced. (Page 769) ..... **clypeata**
   (7) Elytra broadest apically, not narrowed; vertex more roundingly produced, depressed across disc. (Page 771) ..... **grandicella**
9. (7) Costal margin rounding and apex of elytra greatly narrowed; reticulation not prominent at base of elytra. (Page 772) ..... **mollicula**
   (7) Costal margin rounding but elytra not narrowed apically; reticulation prominent over entire elytron. (Page 773) ..... **virescens**

10. (5) Elytron trapezoidal with greatest width at apex; larger insects varying from 6.3 to 7.2 mm. (Page 774)..... **immaculata**
    (5) Elytron either hemispherical with greatest width near middle or else much narrowed at apex; smaller insects, under 6 mm..... 11
11. (10) Vertex considerably extended cephalad beyond eyes, anterior margin rounding but forming sharp angles at junction with lateral margins..... 12
    (10) Vertex not protruded greatly beyond eyes, either truncate or with anterior margin gradually rounding from eyes..... 13
12. (11) Reticulation of elytron much heavier; elytron considerably narrowed apically. (Page 776)..... **similis**
    (11) Reticulation of the elytron scarcely visible on basal and costal areas; costal margins broadly rounding, not particularly narrowed apically. (Page 775)..... **invenusta**
13. (11) Vertex gradually rounding from eyes; no visible carina between vertex and postclypeus; costal margin at most narrowly reflexed; heavy reticulation. (Page 778)..... **pumila**
    (11) Vertex truncate with a visible carina between it and postclypeus; costal margin of elytron greatly expanded..... 14
14. (13) Greatest width of elytron approximately at apex of clavus; reticulation light; costal margin more greatly expanded. (Page 779).... **laticosta**
    (13) Greatest width of elytron anterior to apex of clavus; reticulation heavier; costal margin somewhat less expanded; smaller in size, at least under 4.35 mm. (Page 780)..... **parva**

Acanalonia latifrons (Walker).

(Plates I, III and IV.)

Walker, Francis. List Homop. in British Museum, II, p. 457. *Poeciloptera.*
Dozier, Herbert. Miss. Agric. Exp. Sta., A. and M. College Bull. 14, p. 108, 1926. *Acanalonia.*
Metcalf, Z. P. Jour. Elisha Mitchell Scientific Soc., Vol. XXXVIII, pp. 139–230, 1923.

DESCRIPTION.

Size: Length, ♀, 10.8–12.4 mm.; ♂, 8.7–10.2 mm. Width across eyes, 2.1–2.7 mm. Greatest width of elytron, ♀, 6–6.8 mm.; ♂, 4.65–5.85 mm.

Shape: A large, trapezoidal species with a large, humped thorax as viewed from the side and a very blunt head, greatest width of elytron somewhat anterior to apex of clavus and costal margin of elytron broadly rounded.

Color: General color light green. Vertex and thorax mottled yellowish-green with a distinct yellow band following the prominent median carina. Elytron light green with costal margin and inner margin to apex of clavus yellow. Outer margin and apical portion of inner margin brown, also dark brown cross-dashes in the cells just cephalad of margin. Postclypeus mottled greenish-yellow, anteclypeus tannish across the disc. Eyes reddish, mottled with light. Ventral part of body whitish-green. Coxae of all the legs and also femora and tibiae of hind legs pale. Femora, tibiae, and tarsi of front and middle legs dark brown, the femora mottled with round, pale spots.

Structural Details: Head as viewed from above somewhat produced cephalad beyond eyes, its anterior margin drawn out into a sharp

median angle. A very sharply raised carina across pronotum, mesonotum, vertex and continuing on the postclypeus for a short distance. Vertex and pronotum on median line subequal, the latter, usually slightly longer. Lateral margins of vertex divergent, the latero-cephalic angles projected slightly cephalad. Greatest width of eye a trifle greater than one-third the width of the space between the eyes. Ocelli large and distinct. Antennae typical for the genus, situated in a raised cup-like portion of the gena, the scape ring-like, pedicel bulbous, clavola bulbous at base, black in color, rest setaceous. Postclypeus broad, wider than long, posterior margin indistinguishably sloping into vertex, lateral margins slightly divergent anteriorly to about the middle, then convergent to meet anteclypeus, median carina very distinctly produced posteriorly, only faintly indicated anteriorly. Anteclypeus slightly inflated, invaginated into postclypeus for about one-third the length of the latter and its median length equal to lateral margin of postclypeus. Labrum long, approximately one-half length of anteclypeus. Pronotum as wide as width of head across the eyes, anterior margin roundingly produced, lateral margins short and slightly divergent, posterior margin broadly and shallowly emarginate. Mesonotum subequal in length and width, the median carina very distinct and two round depressions indicated posteriorly. Elytron roughly trapezoidal, the costal margin broadly arched, at base sharply reflexed, the outer margin weakly convex. M vein dividing into M_{1+2} and M_{3+4} near main trunk of Sc, R, and M; M_{3+4} simple throughout, unbranched; M_{1+2} curving cephalad so that veins Sc, R, and M are crowded together nearer the costal margin than in the other species, short, its branches evident before apical reticulated area. Wings milk-white, as long as elytra. Posterior margin of last complete ventral segment of female sinuate, at the middle slightly produced caudad into a broad, very shallow round lobe, the extreme lateral angles produced caudad considerably.

Comparative Notes: See under this heading in the description of *servillei*.

Distribution: Van Duzee's catalogue records this species from North Carolina, Georgia, Florida and Louisiana. Dozier adds Mississippi to this list. R. H. Beamer took one specimen in Batesburg, South Carolina and the Snow collection had one specimen from Pennsylvania.

Hosts: Dozier reports that numbers of this species have been taken by sweeping roadside vegetation and many were also taken on young pecan nursery stock in Mississippi. He states that "the native host plant is not known but probably will prove to be hickory." John B. Gill took one specimen in Havana, Florida, on pecan.

Acanalonia servillei Spinola.

(Plates I, III and IV.)

Spinola. Sur les Fulgorelles. Ann. Soc. Ent. France, Ser. I, VIII, p. 448, 1839.

DESCRIPTION.

Size: Length, ♀, 14.4 mm. Width across eyes, 3 mm. Greatest width of elytron, ♀, 8.4 mm.

Shape: A large, trapezoidal species with blunt head and greatest width of elytron at, about, or caudad to, apex of clavus and costal border of elytron nearly straight posteriorly.

Color: Testaceous-green in preserved specimens, probably bright green in life. Head and thorax uniformly testaceous or greenish (?). Elytra testaceous-green with inner margin as viewed from side faintly brown and delicate brown cross-streaks between the apical veins or apical margin. Clypeus and ventral part of body uniformly yellowish-testaceous. Eyes reddish-brown, mottled with light. Coxae and femora of all the legs and tibiae of hind legs pale. Tibiae of front and middle legs and all the tarsi dark brown, the femora mottled with round, pale spots.

Structural Details: Head as viewed from above somewhat produced cephalad beyond eyes; its anterior margin somewhat conical. A very sharply raised carina across pronotum, mesonotum, vertex and continuing on to the postclypeus for a short distance, more pronounced on mesonotum than anteriorly. Pronotum on median line only slightly longer than vertex. Lateral margins of vertex divergent, the latero-cephalic angles projected slightly cephalad. Greatest width of eye approximately one-third the distance of vertex between the eyes. Ocelli very large and distinct. Antennae typical for the genus, situated in a raised cup-like portion of the gena, scape ring-like, pedicel bulbous, clavola bulbous at base, black in color, rest setaceous. Postclypeus broad, wider than long, posterior margin sloping indistinguishably into vertex, lateral margins subparallel for two-thirds their length, then converging to meet the anteclypeus, median carina distinct posteriorly, obsolete anteriorly. Anteclypeus slightly tumid, invaginated into postclypeus for about one-third length of latter. Pronotum as wide or slightly wider than width of head across the eyes, anterior margin roundingly produced, lateral margins short and slightly divergent, posterior margin broadly and shallowly emarginate. Mesonotum approximately one-sixth longer than wide, the median carina very distinct and two round depressions indicated posteriorly. Elytron roughly trapezoidal, the costal margin rounded anteriorly, but nearly straight posteriorly, at base sharply reflexed. Venation, longitudinal veins standing out more distinctly although the cross veins are very prominent also; M vein dividing into M_{1+2} and M_{3+4} near main trunk of Sc, R and M; M_{3+4} branched at extreme apex of wing; M_{1+2} curving cephalad so that veins Sc, R and M are crowded together nearer the costal margin than in other species, short, its branches evident before apical reticulated area. Wings milk-white, as long as elytra. Posterior margin of last complete ventral abdominal segment of the female

sinuate, at the middle produced slightly caudad into a broad, very shallow, round lobe, the extreme lateral angles produced caudad considerably.

Comparative Notes: From the one specimen available for study loaned by Dr. Metcalf, the author was not able to discover any outstanding differences between this species and that of *latifrons*. In the literature the sizes are given as 10–13 mm. for *latifrons* and 14–15 mm. for *servillei*. Metcalf points out the difference between the rounding costal margin of *latifrons* and the more straight margin of *servillei* which is indicated in the drawings on Plate I. This makes the greatest width of the elytron much more cephalad in *latifrons* than in *servillei*, which is at about the apex of the clavus or slightly caudad to it. Other minor differences are that the lateral margins of the postclypeus are more nearly straight in *servillei* that in the other and that M_{1+2} which is apparently always simple in *latifrons* is branched, at least at the tip, in *servillei*.

Distribution: Melichar lists it from South America, Cuba, Jamaica and Florida. Amyot and Serville list it from Pennsylvania. Mr. Z. P. Metcalf sent the writer one from Cuba. Apparently this is a very rare North American species.

Acanalonia fasciata Metcalf.

(Plates I, III and IV.)

Metcalf, Z. P. Journ. Elisha Mitchell Sci. Soc., XXXVIII, p. 190, 1923.

DESCRIPTION.

Size: Length, ♀, 4.9–6.2 mm.; ♂, 4.2–5.6 mm. Width across eyes, 1.39–1.68 mm. Greatest width of elytron, ♀, 2.85–3.3 mm.; ♂, 2.25–2.7 mm.

Shape: A small, decidedly hemispherical species.

Color: General color testaceous, greenish at apex of elytron. A broad brown fascia extending from the compound eyes, across the lateral field of the pro- and mesonotum and gradually attenuated along the sutural margins of the elytra. Rest of body and legs testaceous, the legs washed in brownish color and apices of claws black. Compound eyes brown.

Structural Details: Head as viewed from above roundingly and only slightly protruding beyond eyes, slightly wider across eyes than pronotum. Vertex slightly depressed, a very faint median carina present, the lateral margins anteriorly strongly diverging. Length of vertex and pronotum on median line equal. Width of eye about one-third the distance between the two eyes. Ocelli bead-like, distinct, located in genal cavity between postclypeus and eye and cephalad of antenna. Antenna typical for genus with ring-like scape, tannish bulbous pedicel, black clavola with small bulbous base, remaining

segments setaceous. Postclypeus slightly tumid, broad, not quite twice as broad as long. Anteclypeus invaginated into postclypeus for approximately one-third length of latter. Labrum small. Pronotum anteriorly produced, posterior margin broadly emarginate, lateral margins subparallel. Mesonotum slightly wider than long, a median carina present. Elytron with length slightly greater than the width, subhemispherical in shape, longitudinal veins very prominent, reticulation only distinct at apex, costal margin broadly expanded. Venation not constant, cubitus in some cases distinctly two-branched, but in the majority simple; vein M_{3+4} very short, branching near original forking of M; vein M_{1+2} somewhat longer, branching before apical reticulation of the wing. Posterior margin of last complete ventral abdominal segment of the female sinuate, broadly concave on median line until almost touching anterior margin, the lateral angles slightly produced.

Comparative Notes: See under same heading in description of *bivittata*.

Distribution: Metcalf states that the type was taken in Texas and that two paratypes were taken in Arizona. The Kansas biological survey party has collected a large series of sixty or more from Arizona and ten specimens from Zion National Park, Utah.

Acanalonia bivittata (Say).

(Plates I, III and IV.)

Say, Thomas. Jl. Acad. Nat. Sci. Phila., IV, p. 335; Compl. Writ., II, p. 255, *Flata*.
Melichar, L. Ann. k. k. Natl. Hofms. Wien, XVI, p. 183, 1901. *Amphisceta*.
Metcalf, Z. P. Journ. of the Elisha Mitchell Sci. Soc., XXXVIII, pp. 139–230, 1923. *Acanalonia*.
Dozier, H. L. Miss. Agric. Exp. Sta. Bull. 14, 1926. *Acanalonia*.

DESCRIPTION.

Size: Variable. Length, ♀, 6.1–8.4 mm.; ♂, 5.23–7.35 mm. Width across eyes, 1.63–2 mm. Greatest width of elytron, ♀, 3.6–5.4 mm.; ♂, 3–4.5 mm.

Shape: Elytron typically hemispherical in outline, head truncate in front.

Color: Somewhat variable. Older specimens found in collections testaceous. Many specimens greenish-yellow. Freshly killed specimens light green. Two broad brownish fascia extending from the compound eyes across the lateral field of the thoracic nota and gradually attenuated along the sutural margins of elytra. Clypeus sometimes yellowish-green, frequently washed in dark brown. Eyes reddish, frequently ringed with grayish-white. Ventral portion of body, coxae of anterior and middle legs and all of the hind legs whitish-green, testaceous or yellowish-green. Anterior and middle pairs of legs beyond coxae washed in brown. Tarsal claws black at tips.

Structural Details: Head as viewed from above only slightly protruding beyond eyes, anterior margin slightly rounded. Vertex slightly

depressed through middle, lateral margins slightly elevated. Length of vertex and pronotum on median line subequal. Width of vertex between eyes about three times width of compound eye. Ocelli distinct. Antenna, scape ring-like fitting in raised socket of gena, pedicel bulbous, clavola setaceous with blackish bulb at base. Postclypeus considerably broader than long, lateral margins divergent, then suddenly incurved to meet anteclypeus, some specimens with faint indications of bowed lateral carinae, others ecarinate. Anteclypeus approximately same length on median line as lateral margin of postclypeus, dovetailed into postclypeus for approximately one-third the length of the latter. Labrum small. Pronotum wider than head, lateral margins divergent, anterior margin broadly rounded, posterior margin broadly emarginate. Mesonotum, length and width subequal, ecarinate, two depressed brownish spots on posterior third. Elytron hemispherical, costal margin semicircular and somewhat reflexed at base, broadest just caudad of middle, veins very conspicuous, distinct reticulation throughout the entire elytron. Venation fairly constant, vein M_{3+4} very short, branching just caudad of original forking of M; vein M_{1+2} fairly long, branching before apical reticulation of wing, all four branches of M usually forking at apex although sometimes branches are obscured in this reticulation. Last complete ventral abdominal segment of female with posterior margin sinuate, the median third produced caudad into two elongate processes, the lateral angles also produced, concave between the median and lateral projections.

Comparative Notes: This species is very similar to *fasciata* Metcalf. Metcalf states that the former can be recognized from *bivittata* by its small size, pale legs and different genitalia. When some of the smaller specimens of *bivittata* are compared with *fasciata* the difference in size is not so apparent. Two very good distinguishing characters are the venation of the wings and the last ventral abdominal segments of the females. The latter character can be compared by a glance at the drawings on Plate IV.

In *fasciata* the reticulation on the elytron is confined chiefly to the apex of the wing while in *bivittata* it is just as prominent at the base as at the tip.

Distribution: Dozier lists it from Ontario, New York, New Jersey, Pennsylvania, Washington, D. C., Virginia, North Carolina, Georgia, Florida, Ohio, Wisconsin, Minnesota, Iowa, Kansas, Missouri, Arkansas, Texas, Arizona, Mississippi, and from Mexico. The Kansas biological survey party has collected it from Alabama, South Carolina and Louisiana. H. B. Hungerford has collected it from Michigan.

Host Plants: This species is always taken from sweepings of grasslands.

Acanalonia bivittata var. **rubescens** (Melichar).

Melichar, L. Monographie der Acanaloniiden und Flatiden (Homoptera). Ann. K. K. Naturhistorischen Hof Museums, XVI, p. 183, 1901.

DESCRIPTION.

This variety occurs along with the true species but in very small numbers. In a series of approximately four hundred specimens only seven were fully reddish-brown or pinkish colored, while two specimens showed only traces or a faint pinkish cast. The pink coloring seems to replace the green of the true species, occurring chiefly in the cells of the wings, across the head and thorax and less distinct on the face, especially when the latter is more brown than testaceous or yellow-green. The underpart of body in some cases remained unchanged, while in others a distinct pinkish cast is found on the abdomen and even on the thorax. The legs apparently are the same testaceous and brownish color as is the true *bivittata*. The dark longitudinal stripes are visible and practically of the same extent as for the species.

Acanalonia conica (Say).

(Plates II, III and IV.)

Say, Thomas. Jl. Acad. Nat. Sci. Phila., VI, p. 238, 1930; Compl. Writ., II, p. 373. *Flata.*

Dozier, H. Miss. Agric. Exp. Sta., A. and M. College, Bull. 14, p. III, 1926.

Metcalf, Z. P. Journ. of the Elisha Mitchell Sci. Soc., XXXVIII, pp. 139–230, 1923. *Acanalonia.*

DESCRIPTION.

Size: Length, ♀, 10.39–11.64 mm.; ♂, 8.25–9.84 mm. Width across the eyes, 1.65–2.1 mm. Greatest width of elytron, ♀, 5.1–5.8 mm.; ♂, 3.96–5.1 mm.

Shape: A large, trapezoidal species with a distinctly pointed head.

Color: Living specimens and freshly killed specimens are more greenish. Older specimens are testaceous-green or mostly testaceous. Head and thorax testaceous-yellow or yellowish-green, two brownish lateral spots on apex of mesonotum. Eyes reddish. Elytra testaceous, or pale green with a brown inner margin, a somewhat darker brown outer margin with dark brown dashes in the cells just cephalad of margin. Ventral part of body yellowish-white, sometimes washed with green. Legs yellowish or greenish-white, apex of tibia and tarsus washed in brown, tarsal claws dark brown.

Structural Details: Head as viewed from above protruding greatly beyond the eyes, forming a distinct conical angle. Vertex flat without carinae, anterior margin separated from the postclypeus by a sharp carina, lateral margins carinate, slightly diverging anteriorly; on median line somewhat longer than pronotum. Greatest width of eye approximately one-third distance between the eyes. Ocelli large, located in the genal cavity mesad of the eyes and cephalad of the antennae. Antenna typical of the genus with a ring-like scape, bulbous pedicel and setaceous black clavola of which the base also is bulbous. Postclypeus subequal in length and width or somewhat broader than long,

smooth, a median carina which is not always distinct except at apex, lateral margins diverging for half their length, then rounding to meet the anteclypeus, carinate and rather broadly reflexed leaving a distinct groove or hollow on each side between the reflexed portion and tumid central portion. Anteclypeus invaginated into postclypeus not more than one-third the length of the latter. Pronotum collar-like, much longer through middle than at sides, wider than head across the eyes, lateral margins divergent, anterior margin definitely roundingly produced, posterior margin broadly emarginate, two small impressions on disc. Mesonotum subequal in length and width, no distinct carinae, two dark lateral spots near apex. Elytron subtrapezoidal in shape with costal and inner margins almost parallel on distal half, the costal margin expanded and only slightly reflexed at base, the longitudinal veins and reticulation prominent, making distinctly depressed cells between. Venation not particularly constant, M always forking into M_{1+2} and M_{3+4} proportionately very near the main trunk of M, R, and Sc; M_{3+4} fairly short, the branches evident before the apical reticulation of the wing; M_{1+2} fairly long, its branches evident before apical reticulation, all four branches again forking at apex or broken up into the apical reticulation. Posterior margin of last complete ventral abdominal segment of female sinuate with the median portion projected caudad as a long, slender flap, the lateral angles also greatly produced caudad, concave between median and lateral projections.

Distribution: Dozier records this species from Virginia, North Carolina, Mississippi, Louisiana, Ohio, Kentucky, Indiana, Illinois, Missouri, Arkansas, Texas and Tennessee. It is commonly taken in Kansas and has been taken by R. H. Beamer in Florida and Georgia and by P. Oman and R. H. Beamer in Alabama. One specimen in the National Museum collection was taken in Maryland.

Hosts: Dozier lists grape, cowpeas and cotton as host plants and states that Swezy lists osage orange, lilac, corn, ragweed, catnip, milkweed and sugar beet as food plants. One specimen collected by F. C. Bishopp in Texas was taken on *Solanum rostratum* and specimens collected by R. A. Cushman in Louisiana were taken on tiger lily.

Acanalonia clypeata Van Duzee.

(Plates II, III and IV.)

Van Duzee, E. P. Proc. Acad. Nat. Sci. Phila., LIX, p. 496, 1908.

DESCRIPTION.

Size: Length, ♀, 7.8 mm.; ♂, 6.66–7.35 mm. Width across eyes, 1.65–1.8 mm. Greatest width of elytron, ♀, 3.36 mm., ♂, 2.75 mm.

Shape: An elongate, subparallel species, with elytra narrowed somewhat at apex, but the inner and costal margin more subparallel than in *mollicula;* a slightly conical head.

Color: General color pale greenish-yellow or greenish-white. Head and thorax pale yellowish-green. Elytra pale green, becoming whitish along base of costa, the outer margin sometimes brown with brown dashes cephalad to it in the cells. Tarsi washed in brown, apical spines of posterior tibiae and tarsi black.

Structural Details: Head as viewed from above produced anteriorly into a conical angle, not so much as in *conica*, but slightly more than in *virescens*. Vertex slightly depressed across middle, ecarinate, lateral angles anteriorly divergent, its length on median line slightly greater than that of pronotum. Width of eye a trifle less than half the distance between the eyes. Ocelli conspicuous. Antenna typical for the genus, situated in a cup-like elevation on the gena, the scape ring-like, the pedicel bulbous and the clavola black in color, bulbous at base, rest setaceous. Postclypeus broad, about one-third wider than greatest length, base tumid, posterior margin truncate, lateral margins subparallel posteriorly, rounded just anterior to middle, then convergent to meet anteclypeus. Anteclypeus large, tumid, its broad, truncate base dovetailed into postclypeus for at least half the length of the latter and to a point above the ventral line of the eyes. Labrum small. Pronotum slightly wider than head, ecarinate, anterior margin broadly rounded, lateral margins divergent, posterior margin broadly emarginate. Mesonotum, width somewhat greater than length, ecarinate. Elytron, long and narrow, its length twice its greatest width which is about the basal fourth, after which point it becomes narrowed, with costal and inner margins subparallel to the weakly convex apex, costal margin expanded and reflexed; longitudinal veins very distinct, the reticulation evident over entire surface but weaker at the base, less prominent than in other species. Venation, M_{3+4} very short, branched near original forking of M; veins M_3 and M_4 again branched near apex of wing; vein M_{1+2} long, not branched before apical reticulation. Wings as long as elytra, whitish, hyaline or somewhat infuscated. Last complete ventral abdominal segment of the female with posterior margin sinuate, slightly concave on mesal line, then somewhat rounded, again concave, finally forming sharply caudad-projecting lateral angles.

Comparative Notes: Similar to *virescens* because of conical head and size but easily separated by the narrow wings and large anteclypeus. Similar to *grandicella* in coloring, general appearance and large anteclypeus. It is easily separated from *grandicella* by the narrow elytra which are broader anteriorly while in the latter they are broader near the apex, by its more conical head, by its lack of carinae on mesonotum and also between the postclypeus and vertex and by being less depressed across vertex. Similar to *mollicula* also with which it is compared under this heading in the description of *mollicula*.

Distribution: Van Duzee lists it from Utah and Nevada. In the Snow collection are three specimens collected by R. H. Beamer in California and one specimen by F. H. Snow from

Arizona. Five specimens in the National Museum collection were taken in Arizona.

Hosts: David Fox took one specimen at St. George, Utah, on *Salsola pestifer*.

Acanalonia grandicella n. sp.
(Plates II, III and IV.)

DESCRIPTION.

Size: Length, ♀, 8.4–9 mm.; ♂, 7.35 mm. Width across eyes, 2.1 mm. Greatest width of elytron, ♀, 4.8–5 mm., ♂, 3.6 mm.

Shape: An elongate, subquadrangular species with elytra narrow and subparallel.

Color: A very pale whitish-green species. Eyes red. Legs and under part of body pale yellowish-green. Tips of tibial and tarsal spines blackish-brown. Apex of elytron with dark brown dashes just anterior to apical margin.

Structural Details: Head as viewed from above somewhat roundingly protruded anteriorly beyond eyes. Vertex distinctly depressed transversely, a fairly distinct carina separating vertex from postclypeus, length of vertex and pronotum on median line equal. Width of eye slightly less than half the width of vertex between the eyes. Ocelli readily distinguishable in the cavity between the postgenae and eyes and anterior to the antennae. Scape of antenna short, ring-like, pedicel bulbous, clavola black with base bulbous and rest setaceous. Postclypeus much broader than wide; length on median line less than half the length at the sides due to the deep invagination of the anteclypeus. Anteclypeus tumid, very long, over twice length of postclypeus on median line, broadly truncate at base, ecarinate. Labrum small. Pronotum somewhat wider than head, hind margin slightly angularly emarginate. Mesonotum as broad as pronotum, quite long, with traces of three carinae, the lateral ones more prominent than the median. Elytron long, narrow, subparallel, semitransparent, the longitudinal veins very conspicuous, the intervening network less abundant and very faint, making larger cells than in most species. Costal margin of elytron only moderately expanded. Venation, M_{3+4} short, branched, very near the original forking of M; vein M_{3+4} long, not branched before apical reticulated area. Posterior margin of last complete ventral abdominal segment of the female sinuate, produced caudad on median line and also laterally, the lateral angles rounded, concave between median and lateral projections.

Comparative Notes: See under same heading in the description of *A. clypeata*.

Before describing this species as new the writer sent a female and male example to Mr. China of the British Museum, to compare with the type of Fowler's *delicatula*. These specimens seemed to answer fairly well to the written description of the latter. Mr. China reported that this species was not *delicatula*.

He pointed out that the vertex is much narrower and subconical at apex and that the postclypeus is much longer and narrower in *delicatula*. On Plate III are two sketches of Mr. China's which the writer has taken the liberty of copying.

Types: Holotype female, Holtville, California, collected by R. H. Beamer; allotype male, Maricopa Co., Arizona, by R. H. Beamer; two paratype females and one male paratype from Arizona, all in the Snow collection, University of Kansas. Two paratype females in the National Museum, collected from Arizona.

Acanalonia mollicula Van Duzee.

(Plates II, III and IV.)

Van Duzee, E. P. A Preliminary List of the Hemiptera of San Diego Co., Cal. Trans. of San Diego Soc. of Nat. Hist., Vol. 2 (I), p. 42, 1914.

DESCRIPTION.

Size: Length, ♀, 5.5–5.78 mm.; ♂, 5.4 mm. Width across eyes, 2.1 mm. Greatest width of elytron, ♀, 2.4–2.7 mm.; ♂, 2.4 mm.

Shape: A small, slender species with elytra distinctly narrowed at apex, costal margin rounding and head slightly conical.

Color: General color greenish-testaceous with a brownish caste, perhaps more green in life. Head and thorax testaceous or greenish-yellow with a smoky tinge. Elytra uniformly testaceous or greenish except for a narrow brown band on inner margin between the claval veins and the margin itself, also the outer margin faintly brown preceded anteriorly with small faint dashes in the cells. Eyes darkly mottled. Clypeus and ventral part of body dusky-testaceous, anteclypeus sometimes fuscous. Pedicel of antenna fuscous. Legs mottled or washed with fuscous, the tibiae darkest of all.

Structural Details: Head as viewed from above produced anteriorly into a conical angle, but not as much as in *clypeata*. Vertex ecarinate, lateral angles anteriorly divergent, its length on median line slightly greater than pronotum. Width of eyes approximately one-third the distance between the two eyes. Ocelli conspicuous. Antennae typical for the genus, situated in a cup-like elevation on the gena, the scape ring-like, the pedicel bulbous and the clavola black in color, bulbous at base and rest setaceous. Postclypeus with width only slightly greater than greatest length, base tumid, lateral margins subparallel for over half their length then converging to meet margin of anteclypeus. Anteclypeus only slightly tumid, dovetailed into postclypeus for less than half the total length of latter. Labrum small. Pronotum as wide or only slightly wider than head, ecarinate, lateral margins divergent, anterior margin broadly rounded, posterior margin shallowly emarginate. Mesonotum with two lateral carinae, its width somewhat greater than its length. Elytron long and narrow, its length approximately twice its greatest width which is about at a point halfway from base to tip, costal margin sharply reflexed and strongly rounded,

narrowing sharply to the narrow apex, the longitudinal veins very distinct, the reticulation lacking at base but distinct at apical region. Venation, M_{3+4} very short, branched near original forking of M; vein M_{1+2} long, not branched before apical reticulated area. Wings white with brown veins, as long as elytra. Last complete ventral abdominal segment of female broadly rounded posteriorly, posterior margin not sinuate as in other species, across middle of the segment two converging carinae with concavity between.

Comparative Notes: A. mollicula resembles *A. clypeata* very much, but differs by having the costal margin greatly rounded instead of straight as in *clypeata* and the elytra narrowed apically to a greater extent than in *clypeata*. *Mollicula* also has a much smaller and less tumid anteclypeus than *clypeata*. Lastly, the female abdominal segments differ as is shown in figures on Plate IV.

Distribution: Recorded only from California.

Acanalonia virescens Stal.

(Plates II, III and IV.)

Stal, Carolus. Stett. ent. Zeit., XXV, p. 56, 1864.
Fowler, W. W. Biol. Central Am. Homoptera, I, p. 49, 1900.
Melichar, L. Anns. des K. K. Naturhistorischen Hofmuseums, Wien, p. 185, 1902.
Metcalf, Z. P. Journ. Elisha Mitchell Sci. Soc., XXXVIII, p. 139, 1923.

DESCRIPTION.

Size: Length, ♀, 6.3–6.9 mm.; ♂, 5.5–6.3 mm. Width across eyes, 1.7–2 mm. Greatest width of elytron, ♀, 3.9–4.2 mm.; ♂, 3.3–3.79 mm.

Shape: A medium-sized species with wings subhemispherical.

Color: Mostly a testaceous species. In some cases the basal half testaceous and the apex greenish-tan. The veins and expanded costal margin pale yellow. Apical margin and inner margin of clavus with brownish bands. Apex of tibia and tarsal segments and sometimes anteclypeus washed in brown, tarsal claws black. Ventral segments yellowish-tan, sometimes ovipositor washed in brown.

Structural Details: Head as viewed from above slightly protruding anteriorly before eyes, slightly conical as seen from a lateral view. Vertex flat; a fairly distinct carina between vertex and postclypeus; length on middle slightly longer than pronotum. Width of eye about one-third width of vertex. Ocelli small but distinct, located in the genal pocket cephalad of antenna. Scape of antenna ringlike, inconspicuous, pedicel bulbous, clavola black, bulbous at base, rest setaceous. Postclypeus very broad, width twice its length on median line, lateral margins parallel posteriorly for two-thirds their length, then abruptly curving mesad, posterior margin very slightly rounded beyond eyes. Anteclypeus, length on median line subequal to lateral margin of postclypeus, dovetailed into postclypeus for more than one-third the length

of the latter. Pronotum, anterior margin rounded, posterior margin slightly emarginate, lateral margins divergent, greatest width somewhat greater than width of the head. Mesonotum somewhat wider than long. Elytron approximately only one-third longer than greatest width, subhemispherical in shape, longitudinal veins distinct, network of crossveins, making small distinct cells between them. Costal margin of elytron broadly expanded and reflexed. Venation, M_{3+4} in some cases short, branching close to original forking, in others long, branching nearer apex of wing; vein M_{1+2} long, not branched before apical reticulate area. Wings long and milk-white. Posterior margin of last complete ventral abdominal segment of female sinuate, produced caudad on median line into a distinct rounded flap and also laterally, the lateral angles truncate, concave between median and lateral projections.

Comparative Notes: See same heading in the description of *clypeata*.

Distribution: Melichar gives Central America and Mexico as the localities for this species. Fowler lists Mexico, Yucatan, Guatemala and Panama. Metcalf (1923) lists it for the first time from the United States. A series of twenty-three specimens in the Snow insect collection was taken from Brownsville, Texas, by F. H. Snow and from Cameron and Hidalgo counties, Texas, by R. H. Beamer.

Note: Melichar describes this species as being green. In the 23 specimens before the writer none of them were entirely green. Apparently the species fades quickly after being killed and is much greener in life.

Acanalonia immaculata Kirk.

(Plates I, III and IV.)

Kirkaldy. Haw. S. P. A. Exp. Sta. Bull. IV, p. 65, 1907; XII, p. 19, 1913.

DESCRIPTION.

Size: Length, ♀, 7.2 mm.; ♂, 6.3 mm. Width across eyes, 1.9–2.1 mm. Greatest width of elytron, ♀, 4.56 mm.; ♂, 3.9 mm.

Shape: A medium wedge-shaped species with greatest width of elytron at the apical end. Head blunt.

Color: General color varying from light green to testaceous. Head and thorax greenish or testaceous. Elytra light green or partially testaceous. Anal vein frequently reddish-brown. Outer margin reddish-brown. Clypeus, labrum, and ventral portion of body light green or testaceous. Legs pale greenish and testaceous, tarsi darker testaceous. Posterior tibial and tarsal claws black. Eyes reddish.

Structural Details: Head as viewed from above protruding beyond eyes and distinctly rounded in front. Vertex somewhat depressed, lateral margins diverging slightly, meeting the anterior margin at a

sharp, cephalad-projecting angle. Vertex considerably longer than pronotum on median line. Width of eye somewhat more than a third of the distance between the eyes. Ocelli small, bead-like. Antenna typical for the genus, situated in the genal pocket, scape ring-like, pedicel bulbous, clavola with bulbous base and seta black. Postclypeus flatly and gradually fused with vertex so that posterior margin of the latter is visible from a cephalic view of the head, ecarinate, the lateral margins subparallel, distinctly carinate and slightly recurved on each anterior half. Anteclypeus broad, tumid, dovetailed into postclypeus for only one-fourth of its length. Labrum slender, about one-third the length of the anteclypeus. Pronotum collar-like, twice as long on median line as at the sides, about as wide as head, lateral margins very little divergent, posterior margin broadly excavate. Mesonotum ecarinate, length and width subequal. Elytron, length one-fifth greater than its greatest width which is across the extreme apex of the wing and from which the costal margin gradually slopes towards its base, where it is somewhat expanded and reflexed, the longitudinal and cross-veins very heavy. Venation, M_{3+4} short, branched near original forking of M; M_4 branched again near apex of wing; M_{1+2} apparently simple. Posterior margin of last complete ventral abdominal segment of the female concave across middle third, slightly evaginated on median line and again laterad of central concavity, rounding into a caudad-projecting lobe from whence it gradually curves cephalad to the lateral margin.

Distribution: Van Duzee's catalogue lists this from Arizona and Mexico.

Acanalonia invenusta n. sp.
(Plates II, III and IV.)

DESCRIPTION.

Size: Length, ♀, 5.1–5.6 mm.; ♂, 4.26–4.56 mm. Width across eyes, 1.44–1.68 mm. Greatest width of elytron, ♀, 3.24–3.9 mm.; ♂, 2.7–3 mm.

Shape: A small, hemispherical species with short, blunt head.

Color: Perhaps green in life but specimens in collections rather uniformly testaceous. Head and thorax light yellow or testaceous. Elytra testaceous or light greenish-yellow except for whitish costal margin, the claval vein and sometimes the outer margin which is dark brown. Postclypeus testaceous or yellowish-white. Anteclypeus brownish-testaceous or yellow, marked sometimes with darker converging diagonal lines. Legs washed in light brown, posterior tibial and tarsal claws black.

Structural Details: Head as viewed from above distinctly protruding beyond eyes, truncate, anterior margin sinuate, slightly rounding across middle, then concave and again produced cephalad at the sides into sharp lateral angles. Vertex slightly longer than pronotum, somewhat depressed across disc, lateral margins anteriorly divergent. Width of eye about one-half width of distance between the eyes. Ocelli

small, not easily discernible. Antenna situated in a deep, genal pocket, the scape a narrow ring, pedicel large, bulbous, the clavola black and with a bulbous base. Postclypeus gradually fused with vertex so that from a true cephalic view of the face the posterior margin of vertex is visible, broadest just anterior of middle where the lateral margins are expanded and sharply carinate, from which point they converge to meet the anteclypeus. Anteclypeus tumid, truncate at base where it indistinguishably fuses with postclypeus across the middle, dovetailed into the postclypeus for approximately one-third or less of the latter's length. Labrum small. Pronotum collar-like, twice as long through middle as at the sides, wider than head, lateral margins divergent, posterior margin shallowly concave. Mesonotum somewhat wider than long, ecarinate. Elytron, width approximately two-thirds its length, costal margin strongly rounded, outer margin weakly convex, longitudinal veins very distinct, reticulation much fainter, scarcely visible on basal and costal areas. Venation variable, M_{3+4} and M_{1+2} short, branching near the original forking of M, M_{3+4} very frequently taking on a pectinate appearance. Wings vestigial, not visible by external examination. Last complete ventral abdominal segment of female deeply excavated at posterior margin, at the apex of this indentation is a caudal projection which is itself indented, the space between the indented sides and the caudal projection narrower than the width of the projection.

Types: Holotype female and allotype male taken in Chaves County, New Mexico, collected by R. H. Beamer, and twenty-two paratypes collected by P. A. Readio and R. H. Beamer from Chaves County and Roosevelt County, New Mexico. Three paratypes from the National Museum collection taken in Brewster County, Texas.

Comparative Notes: See under same heading in the description of *A. similis*.

Acanalonia similis n. sp.
(Plates II, III and IV.)

DESCRIPTION.

Size: Length, ♀, 4.95 mm.; ♂, 4.2–4.44 mm. Width across eyes, 1.5 mm. Greatest width of elytron, ♀, 3 mm.; ♂, 2.85–3 mm.

Shape: A small, subelongate species with greatest width of elytron at apex of basal half and with inner margin, especially of the males, suddenly sloping into the outer margin, making the apex look much narrowed.

Color: General color light testaceous. Head and thorax yellowish-testaceous. Elytron testaceous except for whitish expanded costal margin and the anal vein and outer margin which are faintly brownish. Eyes golden-brown. Face yellowish-testaceous except for reddish-brown converging diagonal streaks on anteclypeus. Ventral segments

of body and coxae cream-white, rest of leg segments testaceous, tarsi dark testaceous. Tips of posterior tibial and tarsal claws black.

Structural Details: Head as viewed from above distinctly protruding beyond eyes, slightly rounded anteriorly and with laterocephalic angles very sharp. Vertex of head longer than pronotum, depressed across disc, lateral margins diverging anteriorly. Width of eye somewhat greater than one-third width of vertex between the eyes. Ocelli small and indistinct. Antenna situated in genal pocket between overlapping carinate margin of postclypeus, typical for genus with ring-like scape, bulbous pedicel and black clavola which is bulbous at base, then becoming setaceous. Postclypeus so gradually fused with vertex that from a true cephalic view of face the posterior margin of the vertex is visible, broadest just anterior to middle, lateral margins converging cephalad to meet the anteclypeus. Anteclypeus tumid, truncate at base where it indistinguishably fuses across the middle with the postclypeus and into which it is projected for approximately one-third the length of the latter. Labrum small. Pronotum collar-like, greatly extended at sides around eyes, anterior margin strongly rounded, about three times as long on median line as behind eyes, lateral margins divergent, posterior margin almost straight across. Mesonotum a trifle wider than long, two lateral carinae visible, somewhat sunken between, sometimes a faint median carina also present. Elytron somewhat longer than wide, greatest width at apex of basal half, costal margin hemispherical, suddenly sloping to outer margin, making apex of elytron, especially in the males, considerably narrowed. Longitudinal veins and apical reticulation raised and prominent, the reticulation visible but not so heavy at base. Venation, M_{3+4} fairly long, branched just before apical reticulation; M_{1+2} very short, branched very near original forking of M, each resulting branch forked again before apical reticulated area. Wings vestigial. Last complete ventral abdominal segment of female deeply indented on posterior margin, at the apex of this indentation a long, slender caudad projection which is itself slightly indented, the space between the indented sides and caudal projection broader than the projection itself.

Comparative Notes: Very similar to *invenusta* in size, coloring and structure, but distinguished from it by the heavier reticulation, narrow apices of elytra and the ventral segment of the female as seen in the drawings on Plate IV.

Types: Holotype, female, from El Paso Co., Texas, collected by R. H. Beamer. Allotype, male, collected by R. H. Beamer from Chaves Co., New Mexico. Three paratype males from El Paso Co., Texas, and one from Presidio Co., Texas, all collected by R. H. Beamer. All types in the Snow collection, University of Kansas.

Distribution: Texas and New Mexico.

Acanalonia pumila (Van Duzee).

(Plates I, III and IV.)

Van Duzee, E. P. Studies in North American Fulgoridae. Proc. Acad. Nat. Sci. Phila., LIX, p. 495, 1908. (*Amphiscepa.*)

DESCRIPTION.

Size: Length, ♀, 4.2–4.44 mm.; ♂, 3.36–3.9 mm. Width across eyes, 1.2–1.44 mm. Greatest width of elytron, ♀, 2.4–2.7 mm. ♂, 2.1–2.4 mm.

Shape: Form of some of the Issinae genus such as *Hysteropterum*. A blunt, somewhat hemispherical species.

Color: General color light green or greenish-testaceous. Head, thorax and elytra of some specimens an even green except for the outer margin and apical dashes in the cells which are brown; legs of these specimens greenish with pale coxae, the tarsi fuscous and the spines on posterior tibiae and tarsi black. Some specimens with head, thorax and ventral parts of body testaceous, while the elytra are more testaceous-green. Eyes reddish or reddish-brown.

Structural Details: Head only slightly rounded before eyes as viewed from above. Vertex ecarinate, smoothly rounding to meet the postclypeus with no visible carinae between them, lateral margins divergent, the laterocephalic angles not sharp as in other species. Vertex and pronotum equal on median line. Width of eye almost one-half width of vertex between the eyes. Ocelli small, protruding. Antenna typical for the genus. Postclypeus, width somewhat greater than length, greatest width at about the insertion of the antennae from whence the lateral margins abruptly incurve to meet the anteclypeus. Anteclypeus short, only about two-thirds length of postclypeus on median line, weakly tumid, dovetailed into postclypeus not over one-third length of latter, the suture between the two obsolete through middle. Labrum small. Pronotum very short behind the eyes, length of median line much greater, equal in width to head across the eyes, anterior margin strongly rounded, posterior margin only very slightly concave. Mesonotum subequal in length and width. Elytron somewhat longer than broad, inner and costal margins subparallel, apex weakly convex, costal region at base not greatly expanded, somewhat reflexed, reticulation very heavy and elevated so that the longitudinal veins stand out less prominently than other members in the genus. Venation, branching of M obscured in the reticulation of the wing, although usually one is able to distinguish M_{1+2} and M_{3+4} with the latter branched again near the original forking of M. Wings white, short, closely appressed to body so not easily visible externally. Posterior margin of last complete ventral abdominal segment of the female sinuate, slightly protruding caudad on mesal line into a small rounded lobe, concave either side of it, again broadly bulging, then concave and finally forming caudad-projecting lateral angles.

Distribution: Van Duzee's catalogue (1919) lists Florida. Dozier (1926) adds North Carolina and states that this species seems limited in distribution to the seashore.

Hosts: Dozier reports that Van Duzee swept a good series from a peculiar succulent plant growing along the seashore in Florida and that Metcalf and Osborn took this species from beach grass about the level of high tide in North Carolina. R. H. Beamer has taken a series from Key Largo and Likley, Florida.

Acanalonia laticosta n. sp.

(Plates II, III and IV.)

DESCRIPTION.

Size: Length, ♀, 4.39–5.4 mm.; ♂, 3.6–4 mm. Width across eyes, 1.39–1.8 mm. Greatest width of elytron, ♀, 3.15–3.84 mm.; ♂, 2.46–3 mm.

Shape: A fairly small, almost square species with a blunt, short head and a broad, expanded costal margin.

Color: General color of museum specimens testaceous with touches of green on elytra. Head, thorax and elytra uniformly testaceous, except for a faint indication of green on veins in apical part of elytron, the whitish costal margin and the faint brownish outer margin. Eyes reddish or reddish-brown. Face and ventral parts of body testaceous, anteclypeus, coxae and tarsi of legs and ovipositor washed in dark brown; tip of posterior tibial and tarsal claws black.

Structural Details: Head very short, as viewed from above, scarcely protruding at all beyond eyes. Vertex shortest through middle, a distinct carina separating it from postclypeus as visible from above, lateral margin of vertex equal to length of pronotum on median line. Eye less than one-third the width of vertex between the eyes. Ocelli apparently lacking. Antenna small, scape ring-like, pedicel bulbous, clavola black with bulbous base and rest setaceous. Postclypeus, one-fourth broader than long, posterior margin rounding, lateral margins decidedly carinate, forming an overhanging ledge so that antennae are scarcely visible from a cephalic view, subparallel for two-thirds their length, then abruptly incurved cephalad to meet anteclypeus, a distinct median carina visible and sometimes two distinct lateral ones running parallel to it. Anteclypeus somewhat short, its length about equal to length of postclypeus on median line, its anterior margin projected into postclypeus for about one-third the length of the latter, slightly tumid. Labrum slender, its length about one-third as long as the clypeus. Pronotum collar-like, encircling the eyes for a considerable distance; approximately twice as long on median line as directly caudad of eye, anterior margin broadly rounded, lateral margins greatly divergent, posterior margin almost straight, two small, round depressions on disc. Mesonotum broader than long, tricarinate. Elytron semitransparent, slightly longer than broad, broadest across base of apical third, costal margin distinctly hemispherical, very broadened and expanded at base, only slightly reflexed, outer margin more strongly convex than in other species, longitudinal veins distinct, reticulation indistinct in costal and radial region. Venation, M_{1+2} and M_{3+4} short, branching near original

forking of M, M_4 again branched before being lost in apical reticulation. Wings vestigial. Posterior margin of last complete ventral abdominal segment of female sinuate, prolonged caudad on median line into a slender, pointed flap, deeply concave on each side of flap, then almost straight to lateral margin of the segment.

Types: Holotype, female, Karnes County, Texas, collected by R. H. Beamer. Allotype, male, collected by J. D. Mitchell from Olivia, Texas. One paratype collected from Karnes County, Texas, which with the holotype is in the Snow collection at the University of Kansas. A large series of paratypes, all from Texas, in the National Museum.

Comparative Notes: See under this heading in the description of *parva*.

Distribution: All specimens at hand were from Texas.

Hosts: They have been collected from the following plants by the following collectors: J. D. Mitchell, on *Helenium* sp., *Croton* sp., and *Anthemis arvensis;* R. A. Cushman, on *Chrysopsis* sp.; W. D. Pierce, on *Siderocarpus flexicaula*.

Acanalonia parva n. sp.
(Plates II, III and IV.)

DESCRIPTION.

Size: Length, ♀, 4.35 mm.; ♂, 3.6–4.2 mm. Width across eyes, 1.38–1.5 mm. Greatest width of elytron, ♀, 2.88 mm.; ♂, 2.52–2.94 mm.

Shape: An exceedingly small oval species, about the size of *pumila*.

Color: General color evenly testaceous, perhaps somewhat green in life. Elytra uniformly testaceous except for reddish-brown outer margin. Eyes brownish or reddish-brown. Clypeus testaceous with converging diagonal brown bands on anteclypeus. Ventral segments of body golden-testaceous. Legs pale testaceous except tarsi which are more brownish. Tips of posterior tibial and tarsal claws black.

Structural Details: Head as viewed from above very little protruded beyond eyes, slightly rounded anteriorly, length on mesal line equal to pronotum. A distinct carina apparently separating vertex from postclypeus, thus making vertex very short, its greatest length thus being on the sides. Width of eye somewhat over one-third of vertex between the eyes. Ocelli apparently lacking. Scape of antenna ring-like, pedicel bulbous but small, deeply placed in genal pocket formed by the overlapping margin of postclypeus, clavola black, bulbous at base, rest setaceous. Postclypeus slightly wider than long, lateral margins subparallel for two-thirds their length, then gradually incurved to meet anteclypeus, very little reflexed, a distinct median carina visible. Anteclypeus equal in length and width, its anterior margin projected into postclypeus for approximately one-third the length of the latter. Labrum slender, approximately one-half length

of anteclypeus. Pronotum collar-like, greatly encircling eyes, lateral margins greatly diverging, anterior margin broadly rounded, posterior margin slightly emarginate. Mesonotum somewhat wider than long, three carinae visible, two roundish spots near apex. Elytron, length about one-fourth greater than width, outline oval, outer margin strongly convex, costal margin hemispherical, base very broadly expanded as in *laticosta*, longitudinal veins distinct at base but lost in the apical reticulated area where the veins are thickened and numerous. Venation, M_{1+2} and M_{3+4} short, both branching near original branching of M, the resulting branches lost in the reticulation. Posterior margin of last complete ventral abdominal segment of female concave in middle, then transversely straight until it reaches the lateral margin where it bends somewhat cephalad.

Types: Holotype, female, Starr County, Texas, collected by R. H. Beamer in July. Allotype, male, Starr County, Texas, collected by R. H. Beamer in July. Ten paratypes taken from Hidalgo, Victoria, Starr and Aranos counties, Texas, by R. H. Beamer and A. M. James in July and August. The types are in the Snow collection, University of Kansas.

Comparative Notes: Very similar in structure and appearance to *laticosta*, but differs by its much smaller size and difference of the last complete ventral segment in the female as shown on Plate IV. About the size of *pumila*, but easily distinguished by the oval shape, broader wings and broad expanded costal margin.

Distribution: Texas.

Acanalonia concinnula Fowler.

(Plates II, III and IV.)

Fowler, W. W. Biol. Centr. Am. Homop., I, p. 49, 1900.

Distribution: Van Duzee's catalogue lists it from Texas and Mexico. Metcalf placed it in his key to the Fulgoridae of Eastern North America. The writer has not been able to study this species.

Comparative Notes: A series of specimens in the Snow collection which at first were taken for this species has been described as a new species, *Acanalonia invenusta*. This was done after Mr. China, of the British Museum, very kindly compared specimens with Fowler's types. Specimens of *laticosta* n. sp. and *invenusta* n. sp. were sent to him. He has this to say concerning his observations:

"I have examined the type of *Acanalonia concinnula* Fowler. It is in very bad condition and it is difficult to make out the characters, but there is no doubt

that it is quite different from either of the two species you have sent. It is a much smaller species, bright green with the whole claval commissure reddish-brown. In general appearance it is entirely distinct from your specimens. Although agreeing in most points with No. II (*invenusta*), it differs in the much shorter frons without a median longitudinal carina and in the shape of the last ventral abdominal segment in the female. The tegmina are much less convex. I inclose rough figures."

Copies of Mr. China's sketches are shown on Plates III and IV.

The ventral abdominal segment of the female, the brown bands on elytra and shape of the elytra indicate the possibility that Metcalf's *fasciata* might be Fowler's *concinnula*. At least the two must be very similar. Neither Mr. Fowler or Mr. China mentioned the presence of brown stripes on head and thorax which are continuous with those of the elytra in *fasciata*. Further checking in regard to this and other points would be necessary before throwing *fasciata* into synonomy.

EXPLANATION OF PLATES.

PLATES I AND II.

Lateral views of species of Acanalonia.

PLATE III.

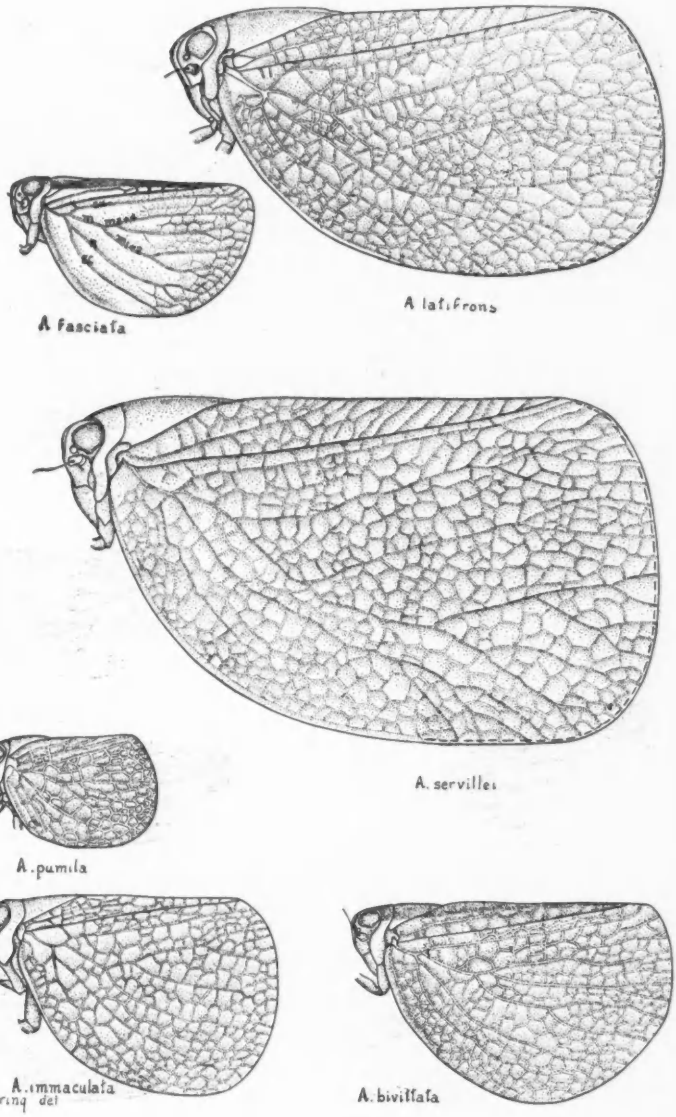
Front view of head and a dorsal view of head and thorax for each species.

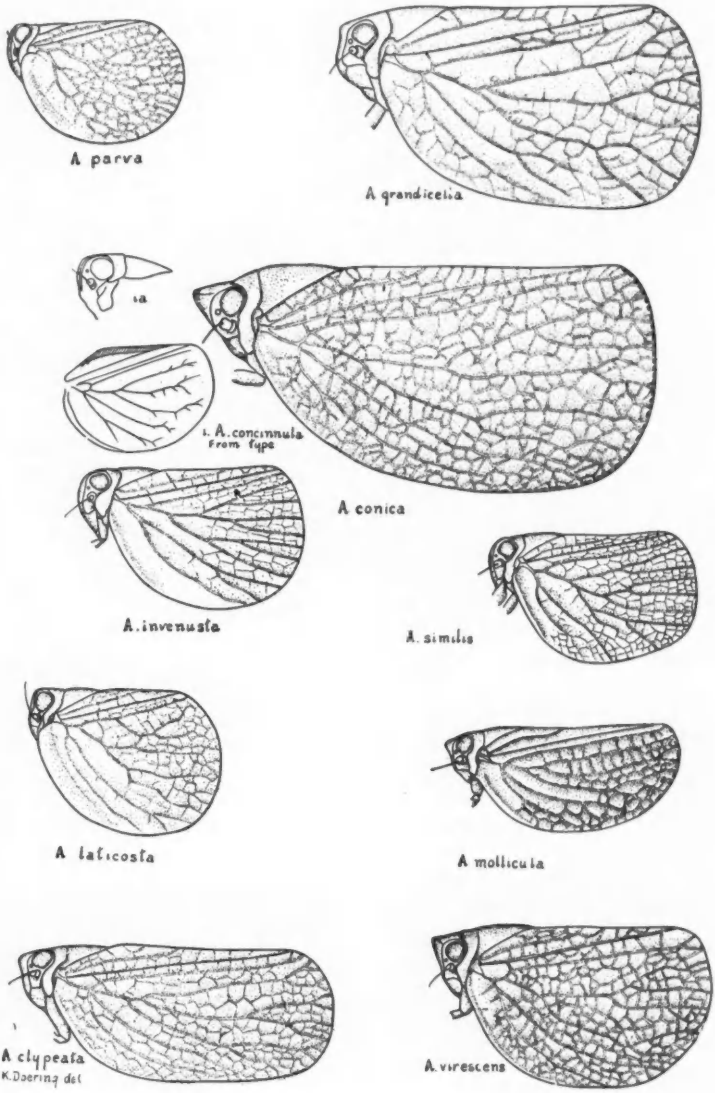
PLATE IV.

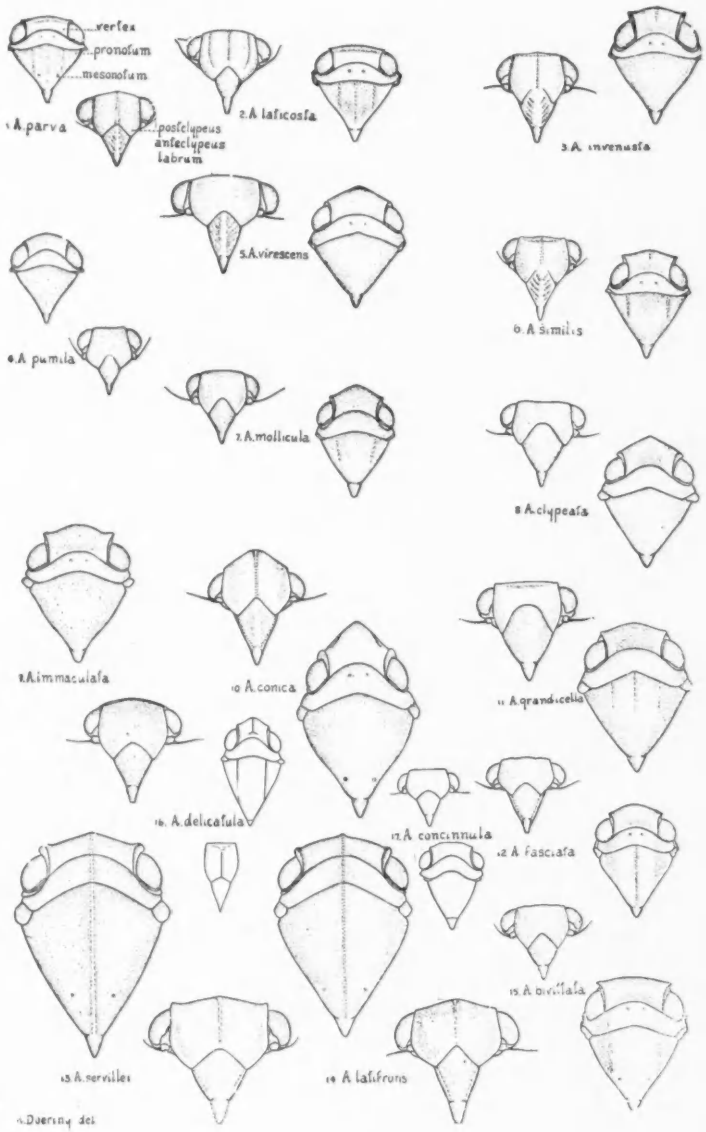
Ventral views of the genitalia of females of Acanalonia.

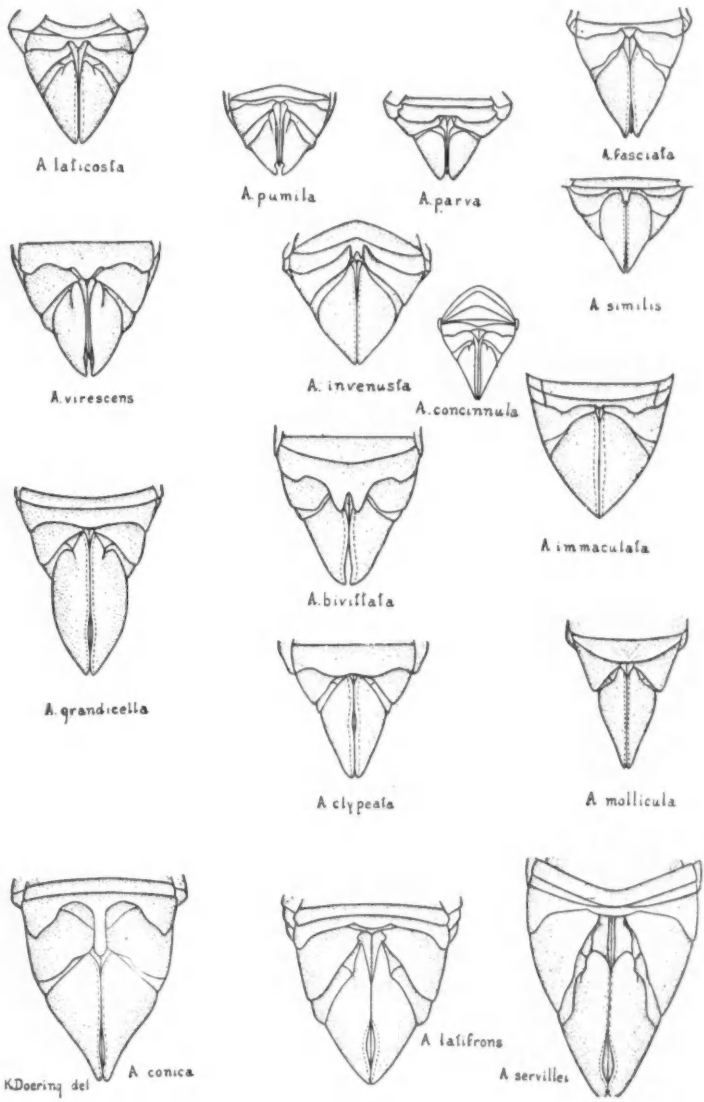
Genus Acanalonia, Fulgoridae
Kathleen C. Doering

PLATE I.




A parva
A grandicella
ta
t. A. concinnula
From type
A conica
A. invenusta
A. similis
A laticosta
A mollicula
A clypeata
K. Doering del
A. virescens


vertex
pronotum
mesonotum
1. A. parva
postclypeus
anteclypeus
labrum
2. A. laticosta
3. A. invenusta
5. A. virescens
6. A. pumila
7. A. mollicula
8. A. clypeata
9. A. immaculata
10. A. conica
11. A. grandicella
12. A. fasciata
13. A. servillei
14. A. latifrons
15. A. bivittata
16. A. delicatula
17. A. concinnula
K. Doering del.


A laticosta
A. pumila
A. parva
A. fasciata
A. similis
A. virescens
A. invenusta
A. concinnula
A. immaculata
A. bivittata
A. grandicella
A. clypeata
A. mollicula
K. Doering del
A. conica
A. latifrons
A. servillei

A REVIEW OF THE NEARCTIC SPECIES OF MACROPSIS.

(Homoptera, Cicadellidae.)*†‡

EDWARD PAUL BREAKEY.

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The genus *Macropsis* was founded by Lewis in 1835 to hold two species, *Cicada virescens* Gmel., and *Cicada flavicollis* Linn., each being placed in a separate division. In 1837, Burmeister, while engaged in splitting up Germar's genus *Bythoscopus*, erected the subgenera *Oncopsis* and *Pediopsis* with *Macropsis* Lewis as the synonym of each. No genotype was fixed for *Oncopsis*, but *Bythoscopus tiliae* Germ. was cited as the typical species of *Pediopsis*. Westwood, in 1840, cited *Cicada flavicollis* Linn. as the type of *Macropsis* Lewis. Burmeister's genus *Pediopsis* therefore became a synonym of *Macropsis* Lewis.

These type fixations were ignored by the older writers, and it was not until 1906 when Kirkaldy pointed out the synonymy that the change was made. As a result much confusion has

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*Dissertation presented in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Graduate School of The Ohio State University.

†Contribution No. 109, from the Department of Zoology and Entomology of the Ohio State University.

‡A Taxonomic, Biologic and Faunistic Study of the Nearctic Forms.

prevailed in the nomenclature of the Bythoscopid genera; and care must be taken in accepting the generic names assigned to species by their authors without reference to the descriptions.

In 1889, Van Duzee published the first monograph of the nearctic species, of which there were eight known to him. These species were assigned to the genus *Pediopsis*. Later, in 1898, Osborn and Ball secured information on the early stages of a number of species and again published a monograph of the nearctic species of *Pediopsis*. This time fifteen species were recognized as belonging to the group. Since the appearance of their paper several additional species have been described and information concerning the group has accumulated in the literature. The present study is an attempt to bring together as much of this information as possible, putting it into a form where it will be useful and available to future students. The writer recognizes thirty-two species and three varieties as being present in North America. Of them, all but two species and two varieties are indigenous to the nearctic fauna; and ten species and one variety are described for the first time.

At the present time none of these species is known to be a pest of economic importance. Interest in them is chiefly that of the zoologist and naturalist. As a basis for faunistic and biologic studies, they are a most interesting group.

ACKNOWLEDGMENTS.

The present revision was made possible through the kindness and assistance of Professor Herbert Osborn who, in addition to numerous other favors, placed his valuable collections and library at the writer's disposal. To Professor D. M. DeLong, the writer is likewise indebted for the loan of much valuable material and many helpful suggestions. Acknowledgments are also due the following for the loan of valuable collections: The staff of the U. S. National Museum, especially Mr. P. W. Oman; Professor P. B. Lawson of the University of Kansas; Professor C. J. Drake of Iowa State College for the loan of a number of the Van Duzee types; and Mr. W. J. Gerhard of the Field Museum, Chicago, for the loan of his collection and that of the museum. To each of these the writer expresses his thanks and appreciation, and to Professor C. P. Gillette of the Colorado Agricultural Experiment Station for his assistance in the solution of a puzzling problem. The drawings were made by Mrs. C. W. Taft under the author's supervision.

Genus **Macropsis** Lewis.

(Greek: *Macro*, broad—*ops*, face.)

Lewis, Trans, Ent. Soc. Lond., i, p. 49, 1835.
Westwood, Intr. Mod. Classif. Ins. ii, Synop., p. 117, 1840, (names *virescens* Gmelin type).
Pediopsis Burmeister, Gen. Quaed. Ins., pl. 10, 1838. (type *tiliae* Germ.).
Van Duzee, Ent. Am., v, p. 167, 1889, (monograph).
Osborn and Ball, Proc. Dav. Acad. Nat. Sci., vii, p. 111, 1898, (monograph).
Kirkaldy, Haw. S. P. A. Exp. Sta. Bull., 1, p. 345, 1906, (summarizes synonymy).

The leafhoppers of this genus constitute a homogeneous group and are readily distinguished from their nearest allies by the direction of the sculpturing or rugae on the strongly

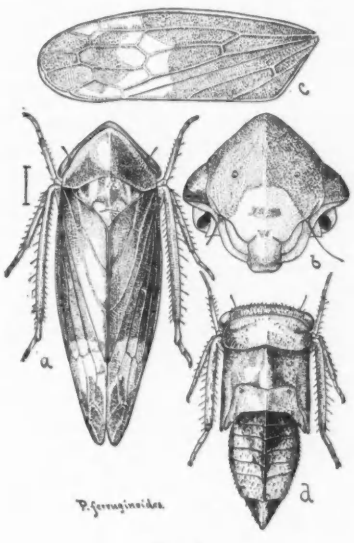

FIG. 1

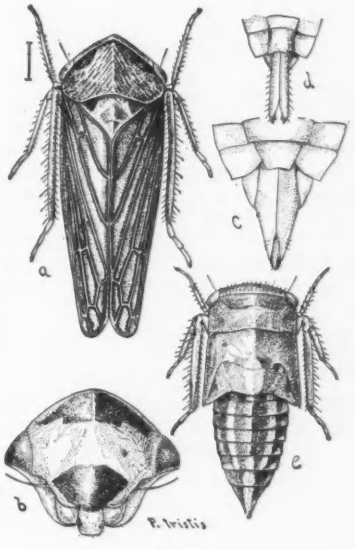

FIG. 2

Fig. 1. *Macropsis* (*Pediopsis*) *ferruginoides; a*, adult; *b*, face; *c*, elytron; *d*, nymph.
Fig. 2. *Macropsis* (*Pediopsis*) *tristis; a*, adult; *b*, face; *c*, ♀, *d*, ♂ genitalia; *e*, nymph.
(Cuts of *ferruginoides* and *tristis*, courtesy of Herbert Osborn.)

angulate pronotum. As stated before, these insects have been known under a number of genera, most of them being assigned to *Pediopsis* Burm. Both *virescens*, the type of *Macropsis*, and *tiliae*, the type of *Pediopsis*, are before the writer. These two species do not differ enough to warrant the retention of the genus *Pediopsis*. When treated as a world wide group it will

doubtless be convenient to break the genus up into smaller units. Such a character as the prominent black spot which is found on the outside near the base of each hind tibia of many palaearctic species might be used. However, such characters can scarcely be considered generic.

The following description characterizes the genus as here treated. It has been drawn from Van Duzee's excellent treatise with modifications and deductions.

Head entirely or almost deflexed, forming a narrow margin to the pronotum when viewed from above; with the eyes, as wide or a little wider than the pronotum. Vertex confounded with the front, rugae radiating from the superior apex in the general direction of the ocelli; ocelli on the face about opposite the middle of the eyes, from which they are less distant than from each other; front bounded by a slight depression, not quite reaching the line of the ocelli; a sharp oblique ridge from the outer angle of the eye to near the base of the clypeus, shielding the base of the antenna. Lorae of the female prominent, tumid; those of the male often reduced and nearly obscured by the swollen and bulging clypeus; outer cheeks narrow below where they are largely covered by the lorae. Clypeus variable in shape and outline, presenting some good specific characters. Pronotum distinctly angulate before, projecting well beyond the anterior extremities of the eyes; sides very short, lateroposterior angles rounded; posterior margin broadly, sometimes angularly concave; rugae radiating from a central line obliquely towards the posterior angles; a pair of distinct impressions or smooth areas on the anterior margin, one a little mesad of either eye. Scutellum broadly triangular, a transverse depression before the apex, and a triangular callosity within either basal angle. Elytra without an appendix, costa more or less arquated, inner margin straight; corium normally with six closed cells, one basal, two discal, and three anteapical; membrane of five apical areoles; clavus with two simple parallel veins terminating on the sutural margin.

The following key will aid in separating the species of *Macropsis* from their relatives in other genera:

KEY TO THE GENERA OF THE BYTHOSCOPINAE.

1. Antennae inserted in a feeble cavity, not covered by a ledge, their bases free 2
   Antennae inserted in a deep cavity beneath a ledge 3
2. Elytra without an appendix ..... **Agallia**
   Elytra with a distinct appendage ..... **Idiocerus**
3. Pronotum distinctly produced beyond the anterior margins of the eyes, vertex angulate anteriorly 4
   Pronotum not produced beyond the anterior margins of the eyes, vertex rounded anteriorly ..... **Bythoscopus**
4. Pronotal rugae transverse, pronotum not distinctly angulate anteriorly, **Oncopsis**
   Pronotal rugae oblique, converging toward the vertex, pronotum distinctly angulate anteriorly ..... **Macropsis**

CHARACTERS USED IN CLASSIFICATION.

An extended search for characters of specific value disclosed that many of those of ordinary recourse, when studying the higher genera of the family, are practically valueless. Osborn and Ball found the external genetalia useless as specific characters; and, with the exception of the *trimaculata* group, the writer found the internal male genitalia of no more assistance. As the search continued, it became apparent that the members of this genus have become specialized along quite different lines.

The anterior angle of the pronotum is constant for the species and varies enough from species to species to be useful. With some it takes the form of a well defined acute-, right-, or obtuse-angle. With others it is not so well defined, appearing more parabolic in outline. The comparative coarseness or fineness of the rugae (the writer had *viridis* Fitch in mind when preparing the descriptions), their relative obliqueness, and the depth of the punctures, are also useful. The length of the anterior impressions, as compared with the long diameter of the eye, might be more useful than indicated. Some value has been attached to the depth of the sinus in the posterior margin and the amount of angulation which it possesses. The amount of convexity possessed by the pronotum is a character employed to some extent.

Characters found in the shape and structure of the face have proved to be the most useful and reliable. The term "face" as used in this paper refers to the entire frontal aspect of the insect. When viewed from the side, the outline of this aspect shows a varying amount of tumidity, in some species approaching flatness, and in others becoming distinctly concave. The rugae on the upper part of the face (vertex), and the punctures lower down, vary somewhat in coarseness and depth from species to species. Of all the characters found in the face, the variations in the shape and tumidity of the clypeus have been the most useful. The lateral margins of this sclerite are usually straight, and vary from being strictly parallel in some species to those in which they show varying amounts of convergence toward the rounded apex. The apex is depressed only on the narrow submargins before the lorae in some species, in others it is depressed entirely across, while in still others it is depressed not at all. In some species the clypeus of the male is of the same shape as that of the

female, while in others it has become greatly swollen basally, merging with the lower part of the front, the lateral margins bulging out over the lorae, often nearly obscuring them. In the latter example the sutures have become obsolete. These variations have been valuable aids in separating males of similar appearance. Drawings which have been prepared for each species, illustrate these characters to greater advantage.

The elytra offer some characters, such as variations in length and breadth, and in thickness. In some species, such as those of the *trimaculata* group, they are short and thick, almost coriaceous in texture, while in others they are thin and more or less hyaline. As auxiliary characters, the strength and prominence of the veins of the elytra have been of some use. In some species they are strong and raised, while in others they are weak and appear little above the upper surface. The reticulate venation of Van Duzee's *nubila* is unique.

Both color and color pattern have proved to be quite constant and specific. In most cases they are the most obvious and accessible characters to use in classification. Most of the exceptions alluded to by earlier workers are now known to be due to a confusion of species. On the whole, the color of a species varies more in intensity than in pattern. The green of some species seems to be quite stable, while in others it quickly fades, the insect becoming yellowish instead.

The heavy maculations with which the anterior impressions on the pronotum of some species are marked, and the fuscous punctures on the disc of others, are useful. Three of our species are known to have the face specifically spotted, and another has the face thickly set with impressed black points. The presence or absence of a black mark on each epimeron is constant enough to be specific. This mark seems to be primarily a character of the males. Less frequently it occurs on females, and those females from which it is normally absent usually possess additional coloration of the male when it is present. It is a characteristic mark of both males and females of a number of species. The under surface of the bodies of many species is pale and immaculate, while in others it is marked in various degrees with fuscous. In so far as known, all introduced species have a prominent black mark on the outside of the hind tibia near the base. No native species is known to have such a mark.

The scutellum of many species bears a blackish or fuscous triangle within either basal angle. In other instances the scutellum may be ornamented with characteristic spots or points. The color or color pattern of the elytra furnishes some of the most obvious and useful characters for sorting out and determining species. They may be of the same shade or color throughout, or they may be varicolored. In the latter case, the color pattern may appear as transverse bands on a hyaline background, as hyaline bands in contrast with the adjacent opaque background, as longitudinal fasciae, as well defined spots, or in various combinations of these.

The above are some of the most useful and dependable characters for defining species in this group. The reader must bear in mind that seldom is one character sufficient to place a species, but the right combination of several characters. Structural characters are the most natural and dependable, but the most difficult to use. For this reason they have been augmented by characters found in the insect's color and color pattern whenever possible.

The following key will aid in seperating the species and varieties from each other:

ARTIFICIAL KEY TO NEARCTIC SPECIES OF MACROPSIS.

1. Elytra reticulate, (S. California). (Page 795) ..... **nubila**
   Elytra not reticulate 2
2. Hind tibiae each bearing a prominent black spot near the base (sometimes obsolete in *virescens*) 3
   Hind tibiae not spotted 6
3. Color fulvous to tawny, all three pairs of tibiae with spots. (Page 801) .. **ulmi**
   Color green, hind tibiae only bearing spots 4
4. Vertex unmarked. (Page 798) ..... **virescens**
   Vertex bearing a prominent black spot at apex 5
5. With two longitudinal black fasciae from vertex onto clavus. (Page 800), **var. latifasciata**
   Without black stripes. (Page 799) ..... **var. graminea**
6. Elytra of the same color or shade throughout (avoid confusing with underlying body color) 7
   Elytra not of the same color or shade throughout 34
7. Elytra green or greenish hyaline, sometimes slightly smoky 8
   Elytra otherwise 20
8. Epimera each bearing a distinct black spot 9
   Epimera unmarked 13
9. Females 10
   Males 11
10. Large, 6 mm. in length, head distinctly angulate anteriorly; head, thorax, and legs usually fulvous. (Page 814) ..... **erythrocephala**
    Smaller, 5 mm. in length, head obtusely angulate anteriorly, body unicolorous. (Page 806) ..... **occidentalis**
11. Extremities of tibiae distinctly banded with black 12
    Extremities of tibiae not banded with black, (Western phase) (Page 814), **erythrocephala**

12. Large, 5 mm. in length, immaculate. (Page 803)..... **trivialis**
Smaller, 4 mm. in length, face distinctly banded or spotted with black. (Page 802)..... **reversalis**
13. Females..... 14
Males..... 19
14. More than 5 mm. in length..... 15
5 mm. or less in length..... 17
15. Body concolorous with elytra..... 16
Head and thorax reddish-brown above. (Page 812)..... **rufocephala**
16. Robust in form, clypeus tumid, keystone-shaped. (Page 804)..... **viridis**
More slender in form, clypeus not so tumid, sides more nearly parallel. (Page 803)..... **trivialis**
17. 5 mm. in length, elytra free of smokiness. (Page 805)..... **hesperia**
Less than 5 mm. in length, elytra smoky..... 18
18. Clypeus nearly parallel-margined, elytra smoky, especially on the clavus. (Page 827)..... var. **gleditschiae**
Clypeus distinctly keystone-shaped, elytra faintly smoky apically. (Page 827)..... **confusa**
19. Robust in form, face long, smokiness of elytra concentrated on claval areas. (Page 827)..... var. **gleditschiae**
Slender, face short, smokiness of elytra wanting or limited to apical areas. (Page 827)..... **confusa**
20. Elytra amber to smoky amber..... 21
Elytra otherwise..... 30
21. Females..... 22
Males..... 24
22. Epimera each bearing a prominent black spot. (Page 816)..... **cinerea**
Epimera unmarked..... 23
23. Head and pronotum green, immaculate. (Page 817)..... **aurifera**
Head and pronotum fusco-punctate above. (Page 823)..... **robusta**
24. Head and pronotum green to yellowish-green, immaculate, abdomen fulvous..... 25
Head, pronotum, and abdomen otherwise..... 27
25. Rugae of pronotum distinct, punctures deep. (Page 806)..... **occidentalis**
Rugae of pronotum less distinct, punctures shallow..... 26
26. Clypeus not basally tumid, lateral margins well defined, nearly parallel. (Page 805)..... **hesperia**
Clypeus basally tumid, lateral margins bulging out over the lorae, the sutures appearing obsolete. (Page 804)..... **viridis**
27. Anterior impressions concolorous with rest of pronotum..... 28
Anterior impressions darkly maculate with fuscous..... 29
28. Large, 4.5 mm. in length, elytra sub-coriaceous, coarsely punctured. (Page 823)..... **robusta**
Smaller, 4 mm. in length, elytra thin, not coarsely punctured. (Page 824), **basalis**
29. Pronotum obtuse-angled before, lateral margins of clypeus bulging out over the lorae. (Page 821)..... **bifasciata**
Pronotum right-angled before, lateral margins of clypeus nearly parallel, distinct, (Eastern phase). (Page 814)..... **erythrocephala**
30. Elytra whitish hyaline, sometimes very faintly greenish. (Page 815)..**pallida**
Elytra brownish-black to black..... 31
31. Females..... 32
Males..... 33
32. Lower half of face and beneath pale, immaculate, epimera unmarked. (Page 809)..... **bicolor**
Beneath nearly black, epimera each bearing a heavy black bar which is obscured by impigmentation, (Western phase). (Page 809)..... **sordida**
33. Beneath pale, stained with fuscous, lateral margins of clypeus bulging out over the lorae, the sutures appearing obsolete. (Page 809)..... **bicolor**
Beneath nearly black, lateral margins of clypeus short and distinct, but nearly parallel, (Western phase). (Page 809)..... **sordida**
34. Face with conspicuous impressed black points or spotted with black..... 35
Face without points or spots, sometimes suffused with fuscous..... 37

35. Green or yellowish-green, elytra greenish hyaline, veins usually brown or brownish-black, (Arizona). (Page 798) ..... **punctifrons**
Brownish or cinereous-brown, elytra brownish-cinereous, sub-hyaline, veins pale 36
36. Large, face with a broad black band above and a large black spot below, veins of elytra pale, narrowly margined with fuscous. (Page 822) .. **tristis**
Small, face thickly set with prominent deep black points, elytra stippled with brownish, veins pale, outlined with impressed black points, (Arizona). (Page 796) ..... **gerhardi**
37. Elytra hyaline with well defined and nearly continuous transverse fuscous bands 38
Elytra otherwise 41
38. Bases of elytra heavily banded with deep brownish or fuscous 39
Bases of elytra free of brownish or fuscous 40
39. Large, 6 mm. in length, head and thorax concolorous with rest of body, male smaller. (Page 817) ..... **osborni**
Smaller, 5 mm. in length, head and thorax reddish-brown above in contrast with the greenish body (female). (Page 824) ..... **basalis**
40. Elytra narrowly twice banded with fuscous, anterior band oblique, interrupted at the claval suture. (Page 821) ..... **bifasciata**
Elytra broadly twice banded with fuscous, anterior band transverse, not interrupted at claval suture. (Page 811) ..... **canadensis**
41. Elytra marked with black or deep fuscous as ill-defined mottlings or patches, or definitely restricted to certain areas or patterns 42
Elytra deep brownish-opaque, marked with a transverse hyaline band or pellucid white spots 44
42. Black of elytra irregularly distributed in the form of mottlings and ill-defined patches. (Page 809) ..... **sordida**
Black of elytra definitely restricted to certain areas or patterns 43
43. Clavus deep black, corium of female green, that of male smoky amber. (Page 808) ..... **suturalis**
Black or fuscous of elytra spreading down to near costa, costa green or greenish hyaline. (Page 825) ..... **fumipennis**
44. Elytra deep brownish-opaque, a transverse hyaline band before the apex ... 45
Elytra brownish-opaque, marked with round pellucid white spots or not at all 47
45. Elytra uniformly ferruginous-brown, hyaline band narrow 46
Elytra blackish, hyaline band usually indefinite, black in base of elytron often confined to corium and concentrated along costa. (Page 819), **nigricans**
46. Head strongly angulate before, epimera with heavy black spots. (Page 813) ..... **ferruginoides**
Head not strongly angulate before, epimera unmarked. (Page 816), **delongi**
47. Blackish-brown, three pellucid white spots on the corium, clavus cinereous. (Page 828) ..... **trimaculata**
Brownish, one pellucid white spot on corium, if male, usually none, clavus concolorous with corium. (Page 830) ..... **insignis**
Reddish-brown, a pellucid white spot on the corium and one on the base of clavus. (Page 832) ..... **quadrimaculata**

Macropsis nubila (Van D.).

Pediopsis nubila Van D., Ent. Am., vi, p. 37, 1890.

Differs from all known species of *Macropsis* by the reticulate-veined elytra. Length: female, 4 mm., width, 1.5 mm. Male unknown.

Pronotum parabolically obtuse-angled before, scarcely convex, anterior impressions as long as the long diameter of the eye; the

oblique rugae present in all other species appear to have been replaced by very coarse punctures; median line indicated; posterior margin with a shallow angulate sinus. Face nearly flat when viewed from the side, rugae above rather coarse, punctures below more minute. Clypeus of the female longer than its basal width, the sides straight and diverging slightly toward the broadly rounded apex which is depressed only on the narrow submargins before the lorae. Lorae very broad and flat. Elytra broad and short, subcoriaceous, rugose, the veins reticulate, the apex broadly rounded. Scutellum coarsely punctured on the disc.

Color: Cinereous to fulvous, the elytra whitish, maculate with brown. Eyes brown. The brown spots on the elytra tend to be distributed as follows: on the clavus, at either end and in the middle, the central spot appearing to continue over onto the corium where it widens toward the costa. The whitish areas are distinctly pellucid between the veins.

Four female specimens from Los Angeles County, California, Coquillett collector, are before the writer. This species presents a number of characters that would tend to place it as a *Bythoscopus*. The short deeply punctured subcoriaceous elytra would tend to place it there, as would also the striation of the pronotum. However, the head is as wide as the pronotum and is not transverse, the anterior margin of the pronotum being produced well beyond the anterior extremities of the eyes. The pronotum is coarsely striate, or punctate, the striations not definitely oblique as in *Macropsis* nor transversely parallel as in *Bythoscopus*. In addition, there is a partially developed median line or carina on the pronotum so often present in *Macropsis*.

With the above characters in mind the writer cannot agree with Osborn and Ball that the species is a *Bythoscopus* and does not belong to *Macropsis*. The reticulate venation makes it unique among the species known to date.

Host: Unknown.

Location of types: Iowa State College, Ames.

Macropsis gerhardi sp. n.

Pale greenish-brown; face, pronotum, and scutellum strikingly marked with coarse black evenly-set impressed points. Length: female, 4 mm., male, 3.5 mm.; width: female, 1.35 mm., male, 1.25 mm.

Pronotum parabolically obtuse-angled before, moderately convex, elongate anterior impressions shorter than the long diameter of the eye; rugae appearing as coarse oblique punctures, median line wanting;

posterior margin with a moderate angulate incision. Face somewhat tumid when viewed from the side, punctures coarse and evenly distributed, the front bearing a pair of prominent parenthesis-like glabrous areas. Clypeus of the female considerably wider than long, the sides converging rapidly toward the rounded apex which is only slightly depressed on the narrow submargins before the lorae; that of the male, together with the front, greatly swollen, the sides bulging out over the lorae. Lorae of the male reduced to mere lines, those of the female prominent, tumid, and punctate. Scutellum coarsely punctate, a pair of glabrous spots immediately anterior to the transverse impression, the basal triangles tending to become glabrous. Elytra short, subcoriaceous, acutely rounded at the apex, veins strong.

Color: Pale greenish-brown; face, pronotum, and scutellum uniformly and thickly set with coarse black impressed points, including the lorae and clypeus of the female. Clypeus of the male black, sometimes including a central light area. Ocelli brownish, eyes fuscous. The impressed black points of the pronotum and scutellum tend to spread over onto the bases of the elytra. Beneath pale brownish, somewhat stained with fuscous; epimera each bearing a large sooty black spot. Anterior impressions of the pronotum immaculate, also the glabrous spots on the scutellum. Elytra brownish, stippled with fuscous; veins immaculate, paler, outlined with impressed fuscous points. Wings dusky, veins fuscous.

A series of ten specimens, two males and eight females, from Nogales, Arizona, collected by F. W. Nunenmacher in August and September, 1906; a second series of eleven specimens, four males and seven females, from Tucson, Arizona, collected by A. A. Nichol on June 7, 1924; and two female specimens from the Santa Rita Mountains of Arizona, collected by F. H. Snow in June and July, are before the writer. The Nunenmacher specimens are from the collection of W. J. Gerhard, who had recognized them as belonging to an undescribed species, but who was kind enough to permit the writer to describe them here. It gives me considerable pleasure to name the species in Mr. Gerhard's honor, and by so doing to express my appreciation of the favors he has extended, both past and present. The Nunenmacher specimens are deposited as follows: Holotype, female, and allotype, male, in the collection of Herbert Osborn; two paratypes, male and female, in the U. S. National Museum; and six paratypes in the collection of W. J. Gerhard. Of the second series, two specimens, a male and female, have been deposited in the collection of Herbert Osborn; two specimens, a male and female, in the writer's collection; and the remainder in the collections of the University of Kansas.

Host: Unknown.

Macropsis punctifrons (Van D.).

Pediopsis punctifrons Van D., Ent. Am., v, p. 174, 1889.

Pale yellowish-green; face, pronotum, and scutellum with small black spots; elytra greenish hyaline with brownish veins: Length: female, 4 mm., male, 3.25 mm.; width: female, 1.5 mm., male, 1.25 mm.

Pronotum right-angled before, moderately convex; anterior impressions as long or longer than the long diameter of the eye; rugae rather coarse and reticulate, median line wanting; posterior margin roundingly incised. Face quite tumid when viewed from the side; rugae and punctures shallow, somewhat obscure on the front. Clypeus of the female rather narrow, broadest at the base, sides nearly straight, converging somewhat toward the narrowly rounded apex; that of the male somewhat tumid, the sides diverging toward the base, spreading over and nearly obscuring the lorae, sutures indistinct. Lorae of the female of medium width, scarcely tumid. Scutellum very finely punctate on the disc. Elytra short, acutely rounded at the apex, the veins strong.

Color: Pale yellowish-green. Face marked with small black spots; an irregular mark at the apex, a circular one on either side above the ocellus, and two comma-shaped marks facing one another on the upper part of the front; ocelli fuscous, eyes pale. Beneath pale green, epimera each marked with a small black spot. Anterior impressions of the pronotum each bearing a row of 3–5 impressed black points which sometimes coalesce to form a black line; disc sometimes stained with fuscous. Scutellum pale, the basal triangles infuscated, a pair of impressed black points immediately anterior to the transverse impression, the apex infuscated. Elytra hyaline, greenish toward the base, the veins fuscous. Wings hyaline, the veins fuscous.

As a rule the females are lighter in color than the males and sometimes almost immaculate. However, the color pattern is essentially the one given, the difference being due to the amount of pigment deposited.

The specimens studied for the preparation of this description are from Huachuca Canyon, Arizona; Santa Catalina Mountains, Arizona; Tucson, Arizona; and three males from the type series, also from Arizona.

Host: Unknown.

Location of types: Iowa State College, Ames.

Macropsis virescens (Gmel.).

Cicada virescens Gmelin in Linnaeus' Syst. Nat., 13th ed., i, pt. 4, p. 2111, 1788.
Pediopsis virescens Osborn, Me. Agr. Exp. Sta. Bull. 238, p. 90, 1915.

Of the same general color and appearance as *viridis* Fitch, but considerably smaller and of a much more slender form, the

head more distinctly pointed and each hind tibia bearing a conspicuous black spot on the outside near the base. Length: female, 5 mm., male, 4.4 mm.; width: female, 1.25 mm., male, 1 mm.

Pronotum considerable less than right-angled before, moderately convex, anterior impressions as long as the long diameter of the eye; rugae coarser than those of *viridis*, strongly oblique, median line nearly obsolete; posterior margin with a deep angulate incision. Face nearly flat when viewed from the side, often slightly concave below the eyes, rugae and punctures coarser than those of *viridis*, distinct. Clypeus of the female broad, as broad as long, the sides straight and converging toward the rounded apex which is depressed only on the narrow submargins before the lorae; that of the male basally, together with the apex of the front, swollen, the sides bulging out over the lorae, the sutures appearing obsolete. Lorae of the female broad and tumid, those of the male reduced to little more than mere lines. Scutellum nearly impunctate. Elytra long and narrow, narrowly rounded apically, the veins weak.

Color: Female yellowish-green, nearly immaculate. Elytra greenish-hyaline, the veins green. Male yellowish-green, more or less infuscated above. Elytra greenish-hyaline, smoky apically, the veins green. Beneath immaculate, the abdomen more or less infuscated above, the posterior margins of the segments narrowly pale in darker individuals. Basal angles of the scutellum more or less infuscated in both sexes. The hind tibiae of both sexes each bear a conspicuous black spot on the outside near the base. Epimera unmarked.

The writer has recognized specimens of this species from Maine, Massachusetts, Pennsylvania, Ontario, and Wisconsin. Osborn was the first to record the occurrence of this well known European insect in America. He also pointed out that when the hind legs are in a position for leaping, the spots on the bases of the tibiae have a position with respect to the insect's body approaching that of the spots so frequently found on the epimera of American species. As pointed out elsewhere, no American species known to date has the tibiae so ornamented.

Host: Willow, *Salix nigra* Marsh., according to the labels on specimens collected in the Arnold Arboretum by H. K. Morrison.

Macropsis virescens var. **graminea** (Fab.).

Cicada graminea Fabricius, Ent. Syst. Suppl., p. 521, 1798.
Pediopsis graminea Osborn, 20th Rept. N. Y. State Ent., p. 505, 1905.
Macropsis virescens var. *graminea* (Fab.) Weiss & Dickerson, Jl. Econ. Ent., xii, pp. 437–440, 1919.

Differs from *virescens* Gmel. only by the shiny black spot with which the apex of the vertex is ornamented.

Morphologically, this form is the same as *virescens*.

Color: The round shiny black spot at the apex of the vertex is the one color character which distinguishes this variety from *virescens*.

A great many specimens of this form from New York, Pennsylvania, and Wisconsin have been available for these studies. Herbert Osborn was the first to record the presence of this European insect in North America, the specimens on which he based his record coming from Fitch Point, near Salem, New York. D. M. DeLong took numbers of this leafhopper on Presque Isle, Pennsylvania, and the writer found it occurring in numbers near Waterloo, Wisconsin. Weiss and Dickerson have recorded the life history of the species in New Jersey and described the various stages.

Host: Poplar, *Populus nigra* L., according to Weiss and Dickerson. The writer collected the Wisconsin insects from *Salix elegantissima* Koch on which they were breeding. Apparently this insect is more diversified in its food habits than other members of the group.

Macropsis virescens var. **latifasciata** var. n.

Differs from all other forms of *virescens* Gmel. by the two broad black stripes which originate on the vertex between the eyes and extend back over the pronotum and scutellum onto the claval areas of the elytra where they seem to converge.

Structurally, this variety is the same as that of the typical *virescens*.

Color: The color characters are the same as those of *graminea* Fab., with the addition of the two broad black fasciae. These stripes originate on the vertex between the eyes, approaching but not touching either eye nor the spot at the apex, and extend downward in obtuse points toward the ocelli; continue back onto the pronotum where they are separated by nearly the width of one, keeping well within the lateral margins, and cross the scutellum, occupying the basal angles, onto the claval areas of the elytra where they appear to converge.

The above description is based on three female specimens. Holotype, Presque Isle, Pennsylvania, July 10, 1920, D. M. De Long collector, in the collection of D. M. De Long; paratype, Vineland, Ontario, September 10, 1922, Wm. Robinson collector, in the University of Kansas collections; and paratype, Batavia, New York, August 4, 1916, H. H. Knight collector, in the collection of Herbert Osborn.

Host: Occurs along with *graminea*.

Macropsis ulmi (Scott).

Pediopsis ulmi Scott, Ent. Mag., x, p. 129, 1873.

Testaceous-brown, each tibia bearing a black spot on the outside near the base, most pronounced on the third pair. Length: female, 4.5 mm., male, 4 mm.; width: 1.25 mm.

Pronotum sharply right-angled before, strongly convex; anterior impressions as long as the long diameter of the eye; rugae coarse, strongly oblique, median line indicated; posterior margin with a deep angulate incision. Face nearly flat when viewed from the side, rugae and punctures shallow and indistinct. Clypeus very broad, as broad as long, flat, the sides straight, converging slightly toward the rounded semicircular apex which is not depressed; sutures distinct in both sexes. Lorae tumid, somewhat reduced in the male. Scutellum finely crenulate-punctate on the disc. Elytra rather long, broad, and rounding at the apex, the veins strong.

Color: Testaceous-brown to fulvous, greenish in fresh or living specimens. Face and beneath ochraceous, each epimeron bearing a large black spot; tergites of the male blackish, the posterior margins of those of the abdomen narrowly yellowish. The underparts of fresh or living female specimens are greenish with a silvery appearance, the viridity fading to yellowish. Tibiae each with a black spot on the outside near the base, most pronounced on the third pair, extremities of the tarsi blackish. Pronotum ochraceous, sometimes greenish, anterior impressions concolorous. Scutellum brownish-yellow, the basal angles each with a large brown triangle. Elytra deep testaceous-brown, subhyaline, the veins concolorous. Wings smoky hyaline, the veins fuscous.

The specimens before me are from the District of Columbia, and Dresher and Spring Mills, Pennsylvania, males and females. The District of Columbia specimen, a female, bears the host label "Elm" and is dated "vii–2–'92." Those from Dresher bear the host label "Ulmus" and the date "vi–29–'17," the Spring Mill specimens bearing a later date. Thus another European species had become established on the North American Continent as early as 1892. Dr. De Long informs me that Dresher and Spring Mill are in a region where considerable nursery stock is grown. It may be inferred that this leafhopper, like others, has reached this region through the agency of imported nursery stock. It is surprising that more foreign species of leafhoppers have not been added to our fauna in this way. Many species pass the winter as eggs which are concealed under the bark of the younger twigs and branches of the host tree, making it practically impossible to detect their presence. The dormant trees, on arriving at their destination are planted

in the nursery; and with the coming of warm weather, the eggs hatch and another species may become established in a new home.

These specimens agree nicely with Scott's detailed description and leave little question as to their identity. In keeping with so many palaearctic species of *Macropsis*, these insects bear a large black spot on the outside near the base of each hind tibia.

Host: Elm, *Ulmus* sp., probably *americana* L. in this region.

Macropsis reversalis (O. & B.).

Pediopsis reversalis Osborn and Ball, Proc. Dav. Acad. Nat. Sci., vii, p. 69, 1898.

Small, light green; female immaculate, the male with two broad bands, sometimes broken up into spots, on the face; and extremities of the legs and spots on the epimera, black. Length: female, 4.5 mm., male, 4 mm.; width, 1.25 mm.

Pronotum right-angled before, strongly convex; rugae fine, reticulate, indistinct over the entire surface, median line wanting; elongate impressions on the anterior margin shorter than the long diameter of the eye; posterior margin with a moderate angulate incision. Face somewhat tumid when viewed from the side; rugae and punctures fine and indistinct. Clypeus of the female as long as the basal width, the sides straight and converging rapidly toward the rounded apex which is strongly depressed on the narrow submargins before the lorae; that of the male basally, together with the apex of the front, tumid, the sides bulging out over the lorae, the sutures appearing obsolete. Lorae small, tumid, those of the male much reduced. Elytra rather strong, narrowly rounded at the apex.

Color: Light green; pronotum and face of the female yellowish-green, the male with a broad black band above on the face, extending down to the middle of the front in a triangular point, and another between the lower margins of the eyes. Beneath yellowish-green, epimera of the male and the extremities of the fore tibiae and all the tarsi black. Female immaculate, or nearly so, the epimera seldom marked. Elytra greenish hyaline. Wings whitish hyaline, the veins white. Some of the males have the bands on the face reduced to three spots, one on the apex above, and one just within and below each ocellus.

The above description has been drawn from a number of specimens from Iowa, Ohio, and Pennsylvania. The Iowa series contained a number of type specimens. Van Duzee has also collected the species at Colden, N. Y.

Host: Willow, *Salix* sp.

Location of types: Collections of Herbert Osborn, E. D. Ball, and Iowa State College, Ames.

Macropsis trivialis (Ball).

Pediopsis trivialis Ball, Can. Ent., xxxiv, p. 304, 1902.

Resembles *viridis* Fitch, but of a more slender form, the coloration of the male distinct and specific. Female yellowish-green, immaculate; male yellowish-green, spots on the epimera, extremities of the fore and middle tibiae, ultimate segments of the tarsi and tarsal claws, black. Length: female, 5.5 mm., male, 4.5 mm.; width: female, 1.5 mm., male, 1.45 mm.

Pronotum less than right-angled before, moderately convex, anterior impressions as long as the long diameter of the eye; rugae coarser than in *viridis*, reticulate, median line indicated; posterior margin with a shallow angulate incision. Face moderately tumid when viewed from the side, rugae and punctures very fine and indistinct. Clypeus of the female a little longer than its basal width, the sides straight and more nearly parallel than those of *viridis*, the apex depressed only on the narrow submargins before the lorae; sutures distinct, though not as deep as those of *viridis*, the clypeus less tumid and appearing to occupy more nearly the same plane as the face. Clypeus of the male narrower than that of *viridis*, the sides not bulging out over the lorae to the same extent, the apex not as much depressed, and the surface more polished. Lorae of the female broad and tumid, those of the male almost obsolete. Scutellum impunctate. Elytra long and narrower than those of *viridis*, the second apical cell usually more than half the length of the middle anteapical cell, apex narrowly rounded, the veins strong.

Color: Female yellowish-green, immaculate; elytra greenish hyaline, the veins concolorous. Male yellowish-green; spots on the epimera, extremities of the fore and middle tibiae and the tarsal claws, black. Elytra greenish hyaline, somewhat smoky toward the apex. Wings of both sexes whitish hyaline, the veins concolorous.

Numerous specimens of this species from Maryland, Pennsylvania, Ohio, Michigan, Illinois, Wisconsin, South Dakota, Kansas, Oklahoma and Colorado have been available for these studies. This species seems to be nearly as common and cosmopolitan in its distribution as *viridis* Fitch, with which it has often been confused. It will be noted that the males are distinctly marked and resemble more nearly those of *reversalis* O. & B. The females resemble those of *viridis* very closely. However, if one will bear in mind that the female of *trivialis* is a more slender appearing insect, and combine this with the differences found in the contour of the face, the more pointed head, and in the shape of the clypeus, he will be able to separate

the females, in the absence of males, with considerable certainty. These studies do not confirm Ball's remarks on the relationship of this species to *erythrocephala* G. & B., but tend to show that *erythrocephala* belongs to a much different morphological group.

Host: Willow, *Salix amygdaloides* Anders., according to Ball (1). While collecting on the shore of Indian Lake, Ohio, on July 3, 1931, the writer swept an isolated willow shrub from which he obtained males and females of this species in numbers. No other species of *Macropsis* were present on this host. In Ashtabula County, Ohio, however, the species was swept from a thicket of mixed willows in association with other forms of *Macropsis*.

Location of types: Collection of E. D. Ball.

Macropsis viridis (Fitch).

Pediopsis viridis Fitch, Homop. N. Y. State Cab., p. 59, 1851.

Female yellowish-green, immaculate; male yellowish-green, elytra amber-brown, epimera each bearing a broad black dash, abdomen fulvous, the tergites blackish. Length: female, 5.5 mm., male, 4.5 mm.; width: female, 1.8 mm., male, 1.5 mm.

Pronotum right-angled before, moderately convex, anterior impressions as long as the long diameter of the eye; rugae indistinct, reticulate, those of the males coarser, median line indicated; posterior margin with a moderately deep ovoid incision. Face nearly flat when viewed from the side, slightly concave below the apex in many individuals; rugae and punctures moderately fine and indistinct. Clypeus of the female as wide at the base as long, the sides straight and converging rapidly toward the rounded and depressed apex which is more strongly depressed on the narrow submargins on either side before the lorae; sutures distinct and deep, together with the depressed apex providing a swollen appearance. Clypeus of the male basally, together with the apex of the front, swollen and bulging out over the lorae, the sutures obsolete. Lorae of the female broad and tumid, those of the male very much reduced, linear. Scutellum nearly impunctate. Elytra broad, moderately long, the second apical cell usually scarcely more than half as long as the middle anteapical cell, broadly rounded at the apex, the veins strong.

Color: Female yellowish-green, immaculate; elytra greenish hyaline, the veins green. Male yellowish-green; elytra amber-brown, the veins concolorous, a broad black mark on each epimera, abdomen fulvous above, the tergites more or less fuscous. Wings whitish hyaline to smoky, the veins concolorous.

Specimens from Maine, Ontario, New York, Pennsylvania, Ohio, Indiana, Illinois, Wisconsin, Minnesota, Iowa, Kansas,

Colorado, Utah, and Oregon have been available for these studies. Van Duzee (11) also records the species from New Hampshire, Quebec, New Jersey, North Carolina and Missouri. This is apparently one of the most universally common species in North America. To date it has not been recorded west of Colorado. Specimens of both sexes from Josephine County, Oregon, F. W. Nunenmacher collector, before the writer are indistinguishable from the form occurring in this locality. Several female specimens from the Sardine Canyon, Utah, D. M. De Long collector, have also been placed here.

In the past, *viridis* Fitch has been confused with other species with which it is commonly associated and which it resembles. The writer attributes the variations mentioned by others as resulting from the confusion, having found the species quite stable in its characters.

Host: Willow, *Salix longifolia* Muhl.

Location of type: Fitch collection, New York State Museum, Albany.

Nymphs: The nymphs, both males and females, imitate the adult in color. They are stout, with transverse head and convex thorax; the abdomen is broad and crested, each segment being elevated into a backward projecting tooth. They are found on the rapidly growing shoots of the host plant near the point of attachment of the leaves, where their color and shape afford them excellent means of concealment.

Macropsis hesperia sp. n.

Resembles *viridis* Fitch in coloration, but smaller and more yellowish, the males distinctly tawny, and presenting rather pronounced structural differences. Length: female, 5 mm., male, 4.5 mm.; width: female, 1.6 mm., male, 1.35 mm.

Pronotum parabolically obtuse-angled before, strongly convex, anterior impressions scarcely as long as the long diameter of the eye; rugae, when compared with those of *viridis* very fine and indistinct, median line indicated in the male only; posterior margin with a shallow angulate incision, more deeply angulate in the male, more so than in *viridis*. Face somewhat tumid when viewed from the side, rugae and punctures very fine and indistinct. Clypeus of the female not so tumid as in *viridis*, as long as the basal width, sutures not so deep as in *viridis*, the sides straight and nearly parallel to the broad truncate apex which is depressed most strongly on the narrow submargins before the lorae; that of the male not tumid as in *viridis*, the sides distinct and parallel to near the base. Lorae of the female broad and

tumid, those of the male smaller, tumid. Scutellum impunctate. Elytra long and rather broad, broadly rounded at the apex, the veins weak.

Color: Female bright yellowish-green, immaculate; eyes fuscous. Elytra lactean-green, hyaline, the veins concolorous; wings whitish hyaline, the veins concolorous. Male distinctly fulvous or tawny above, shading to paler yellowish beneath, the epimera each bearing a prominent black spot. Abdomen with a distinct reddish cast above, the tergites guttate with fuscous anteriorly. Elytra pale amber-brown, the veins concolorous; wings pale smoky hyaline, the veins fuscous.

The above description is based on twenty-four specimens, twelve males and twelve females: Twelve from Blackfoot, Idaho, June 26, 1930, D. M. De Long collector; two from Shoshone Basin, Idaho, July 27, 1930, D. M. De Long collector; and ten from Alto, New Mexico, June 24, 1923, K. C. Doering collector. Holotype, female, Blackfoot, and allotype, male, same data, in the collection of D. M. De Long. Two paratypes, Shoshone Basin, and four paratypes, Blackfoot, three males and three females, also in the collection of D. M. De Long. Two paratypes, Blackfoot, and two, Alto, two males and two females, in the collection of Herbert Osborn; two paratypes, Blackfoot, male and female, and two, Alto, male and female, in the U. S. National Museum; two paratypes, Blackfoot, male and female, in the author's collection; and six paratypes, three males and three females, in the collections of the University of Kansas. The writer has also recognized this species from Colorado.

This species is unquestionably more closely related to *viridis* Fitch and *occidentalis* Van D. than to any others known to date. In fact, it might be considered a race or variety of *viridis*, as might also *occidentalis*. However, it presents definite structural characters, such as the shape of the pronotum, the fineness of the rugae, and the shape of the clypeus, together with other variations that render it distinct. The same is also true of *occidentalis*, and since both appear to be rather definitely restricted in their ranges and no intergrades have come to light, it is thought best to treat them as species. It is certain that they cannot be treated as color varieties.

Host: Probably Willow, *Salix* sp.

Macropsis occidentalis (Van D.).

Pediopsis occidentalis Van D., Psyche v, pp. 238–241, 1889.
Macropsis occidentalis Van D., Trans. San Diego Soc. Nat. Hist., ii, p. 52, 1914.

Resembles *viridis* Fitch in size and coloration, but coarser, rugae and punctures very coarse, the epimera of both sexes bearing sooty black spots. Length: female, 5 mm., male, 4.25 mm.; width: female, 1.75 mm., male, 1.5 mm.

Pronotum parabolically right-angled before, somewhat convex, anterior impressions as long as the long diameter of the eye; rugae, when compared with those of *viridis*, very coarse, coarser in the male, reticulate, median line present; posterior margin with a deep angulate incision. Face flat when viewed from the side, rugae and punctures coarse and distinct. Clypeus of the female as broad as long, the sides straight and converging apically, though more nearly parallel than in *viridis*, sutures deep and distinct; apex broadly depressed for its entire width. Clypeus of the male not tumid as that of *viridis*, the sides straight and parallel to the base, apex depressed as in the female. Lorae of the female broad and tumid, those of the male tumid though somewhat reduced. Scutellum shallowly punctate on the disc. Elytra broad and long, acutely rounded at the apex, veins strong.

Color: Female uniform dull greenish-yellow; elytra greenish hyaline, the veins concolorous; wings whitish hyaline, veins concolorous. Male colored much as the male of *viridis*, but darker; elytra amber-brown, the veins concolorous; head and thorax tawny, pronotum stained with fuscous; abdomen fulvous, the tergites guttate with fuscous, especially anteriorly. Epimera of both sexes marked with a sooty black spot.

Specimens before the writer are the types from Los Angeles County, California, Coquillett collector; and several from the San Jacinto Mountains of California, R. H. Beamer, collector. Van Duzee also records this species from Nevada. The specimens collected by R. H. Beamer show that the female, when living, is of a more definite green than museum specimens would lead one to think. This species resembles *viridis* Fitch in many ways. However, the coarse rugae and the spots on the epimera ought to separate the females at once from those of *viridis;* and the very coarse rugae and lack of tumidity of the clypeus and front ought to place the males.

The writer does not consider Van Duzee's discussion of the relationship of this species to the European forms altogether tenable, when viewed in the light of our accumulating knowledge of this interesting group. Also, it is quite evident in this instance, that he treated at least two species as *viridis* Fitch. Such a species as *punctifrons* Van D. lends itself more readily to such a discussion of faunistic relationships.

Host: Willow, *Salix* sp., according to Van Duzee.

Location of types: Iowa State College, Ames.

Macropsis suturalis (O. & B.).

Pediopsis suturalis Osborn and Ball, Proc. Dav. Acad. Nat. Sci., vii, p. 67, 1898.

Female green, clavus black; male sordid greenish, clavus black. Length: female, 5.5 mm., male, 5 mm.; width: female, 1.85 mm., male, 1.6 mm.

Pronotum right-angled before, moderately convex, elongate anterior impressions longer than the long diameter of the eye; rugae rather coarse, median line obsolete; posterior margin with a shallow angulate incision. Face concave before the eyes when viewed from the side, rugae and punctures fine and obscure. Clypeus of the female very broad, a little longer than the basal width, sides straight and parallel to the broadly rounded depressed apex which is most strongly depressed on the narrow submargins before the lorae; that of the male basally, together with the apex of the front, greatly swollen, the sides bulging out over the lorae, the sutures appearing obsolete. Scutellum scarcely punctate on the disc. Elytra rather long, broadly rounded at the apex, the veins weak.

Color: Female green, immaculate except for the black dorsal stripe which occupies the entire claval areas of the elytra and extends back to the apex. Wings whitish hyaline, the veins concolorous. Male sordid greenish which renders the black dorsal stripe less evident than in the female. Elytra smoky translucent, the same areas black as in the female; scutellum sordid greenish on the disc, each basal angle marked with a black triangle; pronotum and vertex deeply stained with fuscous; eyes reddish. Beneath paler, face stained with fuscous above, pleurites deeply stained with fuscous, epimera each bearing a sooty black dash, tergites of the abdomen black, the posterior margins narrowly yellowish. Wings smoky hyaline, the veins concolorous.

Specimens from Maine, Pennsylvania, Ohio, Iowa, Minnesota, Wisconsin and Kansas are before the writer. The Iowa series includes two cotype specimens. Van Duzee (11) also records this species from New York.

Host: Willow, *Salix amygdaloides* Anders., according to Ball (1).

Location of types: Collections of Herbert Osborn, E. D. Ball, and Iowa State College, Ames.

Nymphs: The nymphs are green in color and marked in general imitation of the adult. A black stripe arises behind either eye and runs back across the wing pads onto the abdomen, keeping just within the margin, to the caudal extremity. In size and shape, they resemble the nymphs of *viridis* Fitch.

Macropsis bicolor (Osb.).

Pediopsis bicolor Osborn, Me. Agr. Exp. Sta. Bull., 238, p. 90, 1915.

Brownish-black above, green below, the viridity fading to yellowish in older and museum specimens. Length: female, 5.5 mm., male, 5 mm.; width, 1.5 mm.

Pronotum right-angled before, moderately convex, anterior impressions as long or longer than the long diameter of the eye; rugae rather coarse, reticulate, median line indicated; posterior margin with a broad angulate incision. Face somewhat concave below the apex when viewed from the side, rugae and punctures fine and indistinct. Clypeus of the female a little longer than its basal width, sides straight and converging somewhat toward the rounded and depressed apex. Lorae broad and tumid. Clypeus of the male basally, together with the apex of the front, tumid, the sides bulging out over the lorae and nearly obscuring them, the sutures appearing obsolete. Scutellum finely punctate on the disc. Elytra rather long and narrow, the veins strong.

Color: Brownish-black above, the front shading to lighter at the middle, but changing rather abruptly to the viridity of the underparts. Beneath green, immaculate in the female except for a large fuscous spot on either side of the pygofer a little behind the middle; the male stained with fuscous, the extremities of the tibiae and the entire tarsi black. Epimera marked with a jet-black spot in the males only. In some specimens the pronotum is quite virescent as is also the upper half of the front. Scutellum dingy greenish on the disc, the basal triangles piceous. Elytra brownish-black, a faintly translucent spot near the apex in some specimens. Wings whitish hyaline, the veins concolorous.

The above description is based on several specimens from Orono, Maine, including a type, a large series of specimens from Ashtabula County, Ohio, one specimen from Birtle, Manitoba, several from Colorado, and one from Massachusetts.

Host: Broad-leaved Willows, *Salix* sp.

Location of types: Collection of Herbert Osborn, and Maine Agricultural Experiment Station, Orono.

Macropsis sordida (Van D.).

Pediopsis sordida Van D., Can. Ent., xxvi, p. 89, 1894.

Somber dirty green in color, the viridity fading. The least handsome species of the genus. Length: female, 5 mm., male, 4.5 mm.; width, 1.5 mm.

Pronotum broadly obtuse-angled before, weakly convex, anterior impressions shorter than the long diameter of the eye; rugae coarse, reticulate, median line indicated; posterior margin with a shallow

angulate incision. Face nearly flat when viewed from the side, rugae and punctures coarse. Clypeus of the female a trifle broader at the base than long, the sides straight and converging toward the rounded depressed apex, sutures distinct and deep. Clypeus of the male shorter than that of the female, somewhat tumid, the basal suture obsolete. Lorae of the female broad and tumid, those of the male very much reduced. Scutellum coarsely punctate on the disc, two large impressed points just anterior to the extremities of the transverse impression. Elytra broad and long, the veins strong.

Color: Green, darkly mottled and stained with fuscous which gives the insect a distinctly dirty appearance. The viridity of fresh or living individuals fades to a yellowish or cinereous hue characteristic of museum specimens. Elytra of the female hyaline, mottled and stained with fuscous, the veins concolorous; those of the male more uniformly deep smoky-brown, the veins concolorous. Disc of the scutellum, pronotum, vertex and face, especially the lower part of the face, greenish. Face stained with fuscous and deeply fuscopunctate. Basal angles of the scutellum shiny black. Beneath greenish, guttate with fuscous, the amount varying, the abdominal tergites narrowly pale posteriorly. The epimera each bear a broad black bar which is obscured by the general pigmentation of the insect. Wings smoky, the veins concolorous.

Numerous specimens from Idaho, Colorado, Ohio, Pennsylvania, Connecticut, Manitoba, and Alberta are at hand for these studies. The Colorado series includes the types. Occasionally the mottling of the elytra of certain females tends to become arranged in bands suggestive of those of *canadensis* Van D. The Ohio specimens, a large series of males and females, were taken from a thicket of mixed willows in Ashtabula County by the writer on June 24, 1931. The Idaho specimens, collected by D. M. De Long, at Ketchum, Alturas Lake, and Stanley Basin, are for the most part darker than the typical form, the pigment being evenly distributed and resulting in an almost uniform jet-black coloration. However, many of these specimens are indistinguishable from those of the type locality.

Van Duzee states that this species is closely allied to *tristis* Van D. The writer is unable to detect this relationship, but considers that it belongs to the willow inhabiting group of which *suturalis* O. & B. is a well known example.

Host: Willow, *Salix* sp.

Location of types: Iowa State College, Ames. An examination of the type series discloses that it contains specimens of three distinct species. However, Van Duzee marked only two specimens, a male and female, as types. These, and two others, belong to the same species and agree with his description

very nicely. The exceptions which he mentions are accounted for by the remaining specimens and his confusion.

Macropsis canadensis (Van D.).

Pediopsis flavescens Van D., Ent. Am., v, p. 173, 1889.
Pediopsis canadensis Van D., Can. Ent., xxii, p. 111, 1890, (n. n. for *flavescens* Van D.)

Pale yellowish-green to greenish-fulvous, the males distinctly fulvous; elytra twice banded with brownish. Length: female, 5.25 mm., male, 4.75 mm.; width: female, 1.75 mm., male, 1.5 mm.

Pronotum obtuse-angled before, moderately convex, anterior impressions as long as the long diameter of the eye; rugae very fine and indistinct, reticulate, coarser in the male, median line obsolete; posterior margin with a deep angulate sinus. Face flat, or nearly so, when viewed from the side, rugae and punctures nearly obsolete. Clypeus of the female as broad as long, the sides nearly straight and converging toward the broadly rounded depressed apex, the sutures distinct; that of the male widened basally to where it joins the front, the sides bulging out over the lorae, sutures obsolete. Lorae of the female not so prominent as in many species, those of the male much reduced. Scutellum impunctate. Elytra long and rather narrow, broadly rounded at the apex, the veins strong.

Color: Head and thorax of the female yellowish-green or greenish-fulvous, immaculate, eyes concolorous, epimera unmarked, the abdomen fulvous, also immaculate. Elytra greenish hyaline, twice banded with brownish-fulvous, once near the middle, and again just before the apex, the veins concolorous. Wings whitish hyaline, the veins concolorous. Male fulvous or tawny, eyes red, epimera each bearing a large black spot. Lower part of the face and beneath paler, episternal pieces slightly stained with fuscous, tarsi black, tergites of the abdomen black. Scutellum cinereous, a brown triangle within either basal angle, a narrow red vitta down the center to the transverse impression which is also reddened. Elytra fulvohyaline, banded much as in the female. Wings smoky, the veins concolorous.

Numerous specimens from Maine, New York, Ontario, Michigan, Minnesota, British Columbia, Colorado, Utah, Idaho, New Mexico and California are available for these studies. Van Duzee also records the species from Quebec. The western examples have the face slightly more tumid and are more fulvous in coloration. Otherwise, they are indistinguishable from those of the type locality. This is a distinct and well marked species and should be easily placed. One well marked specimen from the collection of D. M. De Long is of special interest. It was taken in Fresno County, California, in July, 1919, by F. E. Blaisdell.

Host: Willow, *Salix* sp., according to the labels on various specimens.

Location of types: Iowa State College, Ames.

Macropsis rufocephala Osb.

Macropsis scutellatus Osborn, (preoccupied by *Jassus scutellatus* Boh.), Ohio Biol. Surv. Bull., 14, iii, p. 218, 1928.

Macropsis rufocephala Osborn, Ohio Jrl. Sci., xxxii (No. 6), p. 513, 1932, (n. n. for *scutellatus* Osb.).

Pale yellowish-green, head, pronotum, and anterior two-thirds of the scutellum reddish-brown. Length: female, 5.5 mm., width, 1.6 mm. Male unknown.

Pronotum broadly obtuse-angled before, moderately convex, anterior impressions as long as the long diameter of the eye; rugae fine, distinct, median line present; posterior margin with a rather deep angulate incision. Face concave below the vertex when viewed from the side, rugae and punctures fine but distinct. Clypeus of the female as wide at the base as long, the sides straight and converging toward the broadly rounded depressed apex. Lorae very broad and tumid. Scutellum distinctly punctate on the disc. Elytra broad and moderately long, broadly rounded at the apex, the veins weak.

Color: Pale yellowish-green, upper half of face, pronotum, and anterior two-thirds of scutellum reddish-brown. Basal angles of the scutellum usually blackish, the apical angle and a narrow margin adjacent to the elytra yellowish-green. Elytra lactean green, hyaline, the veins greenish. Wings whitish hyaline, the veins concolorous. Epimera unmarked.

Specimens of this species from Ohio, Wisconsin, Manitoba, Colorado, Idaho and California are before the writer. The Ohio series includes the three types. The California specimen, collected at Knight's Landing by D. M. De Long, bears a small black spot on each epimera by which it differs from all specimens known to date. In all other respects it is indistinguishable from individuals of the type locality. The Colorado specimens, Baker Collection in the U. S. National Museum, came labelled "*erythrocephala* G. & B." Following the treatment of *erythrocephala* G. & B., the writer will explain how such an error in determination probably came about. The name "erythrocephala" is more descriptive of this species than it is of the great majority of the insects to which it was applied. However, both species are entirely distinct and no difficulty should be experienced in placing them.

Host: Willow, *Salix* sp. A number of the Ohio specimens have been taken from this host. The writer found it on willows at Indian Lake and again in Delaware County.

Location of types: Collection of Herbert Osborn.

Macropsis ferruginoides (Van D.).

Pediopsis ferruginoides Van D., Ent. Am., v, p. 171, 1889.

Ferruginous above, lower half of face and all beneath yellow, costa narrowly yellowish, a transverse hyaline band before the apex, epimera each bearing a heavy black spot. Length: female, 5.5–6 mm., male, 5 mm.; width, 1.8 mm.

Pronotum right-angled before, strongly convex, the apex some what tumid, anterior impressions as long as the long diameter of the eye; rugae fine but distinct, median line present; posterior margin with a deep angulate sinus. Face concave above when viewed from the side, rugae and punctures closely set, not very distinct. Clypeus of the female as long as the basal width, the sides straight and nearly parallel to the truncate depressed apex; that of the male widened basally, the basal suture obsolete. Lorae of both sexes prominent, tumid. Scutellum finely punctate on the disc. Elytra rather long and narrow, the apex acutely rounded.

Color: Ferruginous above, lower half of face and all beneath yellowish. Pronotum a little darker on the disc, a series of fuscous spots behind either eye of the male. Scutellum often with five yellow spots: two triangular areas within the basal angles, two circular ones just anterior to the transverse suture, and, less frequently, a triangle at the apex. These spots appear best in darker specimens. Elytra ferruginous, opaque, costa narrowly yellowish, a transverse hyaline band before the apex which includes the crossveins at the bases of the anteapical cells. Wings whitish hyaline, the veins concolorous. Beneath yellowish, immaculate except for the large sooty black spot with which the epimera of both sexes are marked.

Specimens from Ohio, Indiana, Iowa, Minnesota, Montana, South Dakota, Nebraska, Kansas, Colorado, and New Mexico have been studied in the preparation of this description. This species is very closely related structurally to *erythrocephala* G. & B., though distinctly and specifically colored.

Host: Narrow-leaved Willows, *Salix* sp., probably *interior* Rowlee.

Location of types: Iowa State College, Ames, and U. S. National Museum.

Nymphs: The nymphs are yellow and brown in general imitation of the adult. Head and pronotum yellowish, rest of the body brown with a transverse band across the wing pads and another across the abdomen. The writer found this species developing on the Sand Bar Willow near the University Bridge, Columbus, Ohio, in June, 1931.

Macropsis erythrocephala (G. & B.).

Pediopsis erythrocephala Gill. & Bak., Hemip. Colo., p. 72, 1895.

Male cinereous-brown to brownish-green, distinctly marked with fuscous; female green, enlivened anteriorly with fulvous, almost immaculate; epimera of both sexes each bearing a heavy black mark. Length: female, 6 mm., male, 5 mm.; width: female, 2 mm., male, 1.6 mm.

Pronotum broadly obtuse-angled before, strongly convex, the apex tumid, anterior impressions as long as the long diameter of the eye; rugae very fine, reticulate, median line indicated; posterior margin with a deep angulate incision. Face distinctly concave beneath the apex, rugae and punctures fine and indistinct. Clypeus a little longer than broad, the sides straight and nearly parallel, apex depressed and roundingly truncate. Lorae broad and tumid. Scutellum almost impunctate. Elytra long and broad, broadly rounded at the apex.

Color: Female green, almost immaculate, enlivened with fulvous anteriorly; eyes reddish-brown, legs green, shading to fulvous basally. Epimera each bearing a large black spot. Elytra pale greenish hyaline, the veins darker. Male cinereous brown to brownish-green, distinctly marked with fuscous. Face fulvous, stained with fuscous, heavier above; beneath fuscous, enlivened with fulvous, the posterior margins of the abdominal segments narrowly fulvous; legs fulvous, often stained with fuscous, tarsi blackish; epimera each bearing a large black spot. Pronotum testaceous brown, deeply stained with fuscous centrally, the anterior impressions guttate with black. Scutellum testaceous brown, a black triangle in either basal angle. Elytra fuscohyaline, the veins darker.

Numerous specimens from Ohio, Indiana, Illinois, Wisconsin, Minnesota, Iowa, Nebraska, Kansas, Colorado, New Mexico, and California are before the writer. The females are consistently colored as described. However, males from Iowa, Colorado and Arizona are somewhat smaller and lighter, in some instances little darker than the females. In a series of nearly forty specimens from various parts of Ohio, not a single light colored male appears. Through the kindness of Professor C. P. Gillette the writer has been permitted to examine a female specimen of this species from the type locality which was pronounced as typical. This specimen has the rusty-brown coloration on the head and prothorax quite pronounced. It was doubtless such specimens as this which suggested the species' name. However, in the writer's experience, such specimens are not at all common. This species is one of the largest of the genus and very distinct.

Host: Willow, *Salix longifolia* Muhl.

Location of types: The types seem to be lost. The type in the National Museum at Washington does not bear the labels designated in the original description and belongs to a different species than that to which it is credited. Professor Herbert Osborn was kind enough to make some comparisons for the writer while in Washington. As a result of these comparative studies, we find that the National Museum specimen belongs to his *scutellatus* which has been renamed *rufocephala*. This discovery accounts for the fact that specimens of *rufocephala* from the National Museum came labelled *erythrocephala* G. & B. Since these species differ greatly in both form and distinctive markings, there should be little cause for confusing them.

Macropsis pallida sp. n.

Pale greenish-white, immaculate except for the sooty black spot with which each epimera is marked. Length: female, 5.5 mm., width, 1.8 mm. Male unknown.

Pronotum parabolically obtuse-angled before, moderately convex, anterior impressions as long as the long diameter of the eye; rugae very fine, reticulate, median line indicated; posterior margin with a rather shallow angulate sinus. Face distinctly tumid when viewed from the side, rugae and punctures fine and indistinct. Clypeus of the female a little longer than wide, the sides straight and parallel, the apex depressed, most strongly on the narrow submargins before the lorae. Lorae broad, moderately tumid. Scutellum finely rugose on the disc, the basal angles smooth. Elytra broad and long, thin, the veins thickened basally.

Color: Pale greenish-white. Elytra whitish hyaline, the veins greenish basally. A creamy white triangle within either basal angle of the scutellum. Eyes reddish. Legs enlivened with fulvous, chiefly the femora, the outer ends of the tibiae and the tarsi. Epimera each bearing an oval black spot.

Description based on ten female specimens: Eight, Boise, Idaho, July 11, 1930, D. M. De Long collector; holotype and three paratypes in the collection of D. M. De Long, two paratypes in the U. S. National Museum, one in the collection of Herbert Osborn, and one in the writer's collection. One, Logan Canyon, Utah, July 24, 1930, D. M. De Long collector, in the collection of D. M. De Long. One, Davis, California, June 6, 1922, B. G. Thompson collector, in the collection of Herbert Osborn.

Host: Unknown.

Macropsis cinerea sp. n.

Cinereous brown above, greenish-fulvous beneath; elytra cinereous hyaline, the veins infuscated, a black triangle within either basal angle of the scutellum, epimera each bearing a large black spot. Length: female, 5 mm., width, 1.5 mm. Male unknown.

Pronotum parabolically obtuse-angled before, slightly convex, anterior impressions shorter than the long diameter of the eye; rugae fine, reticulate; posterior margin with a very shallow angulate sinus. Face tumid when viewed from the side, rugae and punctures fine and indistinct. Clypeus longer than the basal width, the sides straight and strictly parallel to the broadly rounded apex which is not depressed. Lorae broad, but scarcely tumid. Scutellum impunctate. Elytra broad and long, narrowly rounded at the apex, the veins strong.

Color: Cinereous brown above, elytra cinereous hyaline, the veins infuscated, a black triangle within either basal angle of the scutellum, pronotum stained with fuscous, eyes black. Face and beneath greenish-fulvous, immaculate except for the heavy black spots on the epimera. Dorsal surface of the abdomen guttate with fuscous, especially anteriorly on the segments. Wings smoky hyaline, the veins fuscous.

Description based on one female specimen collected by the writer at Indian Lake, Ohio, on July 3, 1931. Holotype in the collection of Herbert Osborn.

Host: Willow, *Salix* sp.

Macropsis delongi sp. n.

Resembles *ferruginoides* Van D. in coloration, but of a different form, belonging to a different morphological group. Length: female, 5.25 mm., width, 1.8 mm. Male unknown.

Pronotum parabolically obtuse-angled before, moderately convex, anterior impressions as long as the long diameter of the eye; rugae fine, reticulate, indistinct, median line obsolete; posterior margin with a shallow oval incision. Face somewhat concave before the eyes when viewed from the side, rugae and punctures fine and indistinct. Clypeus as broad at the base as long, the lateral margins straight and converging toward the broadly rounded apex which is depressed on the submargins before the lorae. Lorae broad and only slightly tumid. Scutellum almost impunctate. Elytra broad and long, the apex, narrowly rounded, veins strong.

Color: Entire body, except the eyes and elytra, pale greenish-yellow, immaculate. Eyes dark fuscous. Elytra dark reddish-brown, opaque except for a transverse hyaline band before the apex which includes the apical fourth of the clavus. Wings pale smoky hyaline, the veins fuscous.

Description based on four female specimens collected by D. M. De Long in Idaho; three, Idaho City, July 13, 1930, and one, Boise, July 11, 1930. Holotype, Idaho City, and paratype, Boise, in the collection of D. M. De Long; a paratype in the collection of Herbert Osborn, and one in the U. S. National Museum.

The writer takes great pleasure in naming this distinctive species in honor of Dr. D. M. De Long, whose recent collecting in the west has brought to light many new species and has added much to our knowledge of the distribution of others.

Host: Unknown.

Macropsis aurifera sp. n.

Dark yellowish-green, the elytra golden brown; immaculate. Length: female, 5.3 mm., width, 1.8 mm. Male unknown.

Pronotum right-angled before, moderately convex, anterior impressions shorter than the long diameter of the eye; rugae fine and reticulate, median line wanting; posterior margin with a moderately deep angulate sinus. Face slightly tumid when viewed from the side, rugae and punctures fine but rather distinct. Clypeus of the female as broad at the base as long, the sides straight and converging rapidly toward the rounded apex which is depressed on the narrow submargins before the lorae. Lorae of moderate width and tumidity. Scutellum finely punctate on the disc, a median carina indicated. Elytra broad and short, exceeding the end of the ovipositor by only half the length of the apical cell, veins strong.

Color: Dark yellowish-green, immaculate. Eyes black. Elytra golden brown, pellucid, the veins concolorous. Epimera unmarked. Wings smoky hyaline, the veins darker.

Description based on six female specimens from Idaho: Five from Idaho City, July 13, 1930, and one from Boise, July 11, 1930, D. M. De Long collector. Holotype, Idaho City, and paratypes in the collection of D. M. De Long, paratype in the U. S. National Museum, one in the collection of Herbert Osborn, and another in the author's collection.

Host: Probably Willow, *Salix* sp.

Macropsis osborni sp. n.

Resembles *basalis* Van D. with which it has been confused, but very much larger and of a different form, the elytra unmarked except for a broad black band bordering the scutellum. Length: female, 6 mm., male, 5 mm.; width: female, 1.8 mm., male, 1.75 mm.

Pronotum parabolically obtuse-angled before, moderately tumid anteriorly, the anterior impressions longer than the long diameter of the eye; rugae fine, reticulate, those of the males coarser, median line obsolete or nearly so in the females, present in the males; posterior margin with a shallow oval incision. Face roundingly tumid when viewed from the side, rugae and punctures coarse and shallow. Clypeus of the female longer than the basal width, the sides straight and parallel, the apex broadly rounded, not depressed; that of the male shorter, the basal suture obscured. Lorae of the female very broad and only moderately tumid, those of the male prominent and tumid. Scutellum nearly impunctate. Elytra long and rather narrow, apex narrowly rounded, the veins strong.

Color: Female yellowish-green; the elytra greenish hyaline, burnished over with a cupreous cast that is most pronounced on the veins, a broad black band bordering the scutellum which is confined to the bases of the claval areas. Beneath immaculate, the epimera unmarked, occasionally bearing an inconspicuous spot. Wings whitish hyaline, the veins faintly smoky. Males greenish, overcast with fuscous; the elytra cinereous hyaline, enlivened with fulvous, most pronounced on the veins, a broad blackish band bordering the scutellum as in the female. Pronotum stained with fuscous, centrally and basally. Each basal angle of the scutellum marked with a large fuscous triangle, the transverse impression fuscous. Beneath immaculate except for the sooty black spot with which each epimera is marked. Dorsal surface of the abdomen infuscated, chiefly anteriorly on the segments. Wings hyaline, the veins smoky.

The above description has been drawn from eighteen specimens, two males and sixteen females: Holotype, Arcanum, Ohio, June 13, 1904, cottonwood, O. H. Swezey collector; allotype, male, same data; paratypes; Ames, Iowa, July 2, 1897; Ft. Collins, Colorado, August 6, 1895; all in the collection of Herbert Osborn. Paratypes: male, Rapid City, South Dakota, June 24, 1923; female, same data; and female, Newell, South Dakota, June 18, 1923, H. C. Severin collector; in the collection of D. M. De Long. Two; Willow Springs, Illinois, June 29, 1913, poplar, W. J. Gerhard collector, in Mr. Gerhard's collection. Three; Colorado, C. F. Baker collection, U. S. National Museum: "Colo. 1584," "Colo. 1563," and "Colo. 1589," in the U. S. National Museum. Three: two, Gray Cloud Island, Minnesota, July 12, 1929, H. H. Knight collector, and one, Ottawa County, Kansas, P. B. Lawson collector; in the collections of the University of Kansas. Two: Ames, Iowa, June 27 and July 12, 1897, in the Iowa State College collections. One, Delaware County, Ohio, July 7, 1931, cottonwood, E. P. Breakey collector, in the author's collection.

The writer takes great pleasure in naming this large and distinctive species in honor of his teacher and benefactor, Herbert Osborn.

Host: Cottonwood, *Populus deltoides* Marsh.

Macropsis nigricans (Van D.).

Pediopsis trimaculata Van D., Ent. Am., p. 172, 1889, (description).
Pediopsis bifasciata O. & B., Proc. Dav. Acad. Nat. Sci., vii, p. 118, 1898.
Macropsis nigricans Van D., Check List Hemip., p. 64, 1916, (n. n. for *trimaculata* Van D.).

Greenish-fulvous to greenish-brown, the viridity quickly fading, with heavy black markings on the basal halves of the elytra and again at the apices; males pale yellowish with the elytra less distinctly marked. Length: female, 5.5 mm., male, 5 mm.; width: female, 1.8 mm., male, 1.6 mm.

Pronotum right-angled before, scarcely convex; rugae coarse and reticulate, median line well defined; anterior impressions shorter than the long diameter of the eye; posterior margin with a shallow angulate sinus. Face somewhat tumid when viewed from the side, rugae and punctures shallow and indistinct. Clypeus of the female longer than its basal width, the sides straight and parallel to the broadly rounded apex which is only slightly depressed on the narrow submargins before the lorae; that of the male much widened toward the base, the sides straight to the rounded apex which is depressed on a narrow submargin from one lora to the other. Lorae prominent and tumid, less so in the male. Scutellum finely punctate on the disc. Elytra broad and long, apex narrowly rounded, the veins weak.

Color: Greenish-fulvous to greenish-brown above, the markings black. Pronotum more or less stained with fuscous, the anterior impressions usually maculate with brown or brownish-black. Scutellum greenish-fulvous, a black or brown triangle within either basal angle, and usually a pair of impressed black points just anterior to the extremities of the transverse impression. Elytra hyaline, a variable amount of black or brownish-black on the basal halves which is usually concentrated along the costa, sometimes spreading to, or onto, the clavus, and a triangular patch at the apex, pointed in the anteapical cells. Face and beneath pale yellowish or yellowish-green, immaculate except for the heavy black spots with which the epimera are marked. Abdominal tergites of the male black, the posterior margins narrowly yellow, those of the female guttate with blackish in very dark specimens. Wings pale smoky hyaline, the veins fuscous.

Specimens from Iowa, South Dakota, Colorado, Nebraska, Illinois, and Ohio are before the writer. Van Duzee also records this species from Ontario and New York. These insects vary considerably in the amount of impigmentation present, but not much in color pattern which is essentially

that described. Specimens taken in Ohio are much darker than those from South Dakota and Colorado. This same condition holds for other species, the darker phases coming from the more humid regions.

Host: Cottonwood, *Populus deltoides* Marsh. The writer found this species developing on cottonwood near the University Bridge at Columbus, Ohio, in May, 1931, and again at Westerville, Ohio. Osborn and Ball also observed it developing on this host.

Nymphs: The nymphs are robust and depressed, the abdomen not elevated into a crest as in the nymph of *viridis* Fitch, but having the general morphological features of those of *tristis* Van D. They are darkly pigmented above, the coloration suggesting that of the adult. A comparison of the nymphs of this species with those of *tristis* Van D. reveals many striking similarities. They were found on the twigs of a previous season's growth in the axils of the leaves, where their shape and coloration rendered them inconspicuous. When disturbed they would dodge around to the opposite side of the branch, refusing to leap under ordinary provocation.

The above synonymy indicates that there is considerable confusion regarding this species and Van Duzee's *bifasciata*. The specimens which Osborn and Ball described as *bifasciata* are before the writer and agree very nicely with the description which Van Duzee wrote supposedly for Fitch's *trimaculata*. Later, recognizing his mistake, Van Duzee proposed the name *nigricans* for the species which he had earlier described as *trimaculata* Fitch.

It has been possible to check the above described insects against the type of *bifasciata* and a considerable number of specimens from Wisconsin, South Dakota, Pennsylvania, and Maine. The Maine specimens had been determined *bifasciata* by Osborn with some hesitancy, since they did not agree with the insects from Iowa which he and Ball had treated as *bifasciata*. This comparison makes it certain that these insects represent a different species than the Iowa and Ohio specimens. Further study also reveals that Van Duzee's description of *bifasciata* fits the type very nicely, and that he likewise described the insects from Wisconsin, South Dakota, Pennsylvania, and Maine.

In the description of *trimaculata*, referred to above, Van Duzee makes this statement: ". . . clavus deep brown;

corium pale grayish white, a large patch near the middle scarcely reaching the claval suture, and extending along the costa to the shoulder, and a transverse band near the apex, brown." At the same time he described his *bifasciata* as: "Elytra whitish hyaline with a transverse fuscous band, displaced on the claval suture, crossing near their middle, and another just before their apex; nervures concolorous." It will be noted that no mention is made of any brown markings on the elytra of *bifasciata* that extend along the costa to the shoulder. Nor is the clavus described as being deep brown. Such markings do not appear in any of the specimens before me which have been determined as *bifasciata*. However, the transverse band which is displaced at the claval suture is distinct and quite uniform throughout the series, as is also the transverse band before the apex. Specimens of *bifasciata* are more robust in appearance than those of *nigricans*, the angle of the pronotum anteriorly is much greater, giving the head a shorter appearance.

Macropsis bifasciata (Van D.).

Pediopsis bifasciata Van D., Ent. Am., v, p. 173, 1889.

Dull greenish-ferrugineous, the viridity fading, paler beneath, elytra grayish hyaline, narrowly bifasciate with fuscous. Length: female, 5.25 mm., male, 5 mm.; width: female, 1.9 mm., male, 1.75 mm.

Pronotum broadly obtuse-angled before, scarcely convex, anterior impressions shorter than the long diameter of the eye; crenulate punctations fine, coarser in the males, median line wanting; posterior margin with a shallow angulate incision. Face rather tumid when viewed from the side, rugae and punctures very fine and obscure. Clypeus of the female narrow, longer than the basal width, the sides straight and converging toward the rounded apex which is slightly depressed on the narrow submargins before the lorae; that of the male basally, together with the apex of the front, swollen and polished, the sides bulging out over the lorae. Lorae of the female conspicuous and rather tumid, those of the male reduced and inconspicuous. Scutellum scarcely punctate on the disc. Elytra long, narrowly rounded at the apex, the veins strong.

Color: Pronotum often stained with fuscous on the disc and posteriorly, sometimes appearing fuscopunctate, the anterior impressions sometimes infuscated. Face and beneath pale honey-yellow, greenish in fresh specimens, immaculate except for the large sooty-black spots on the epimera. Scutellum fuscopunctate on the disc, a black triangle within either basal angle. Abdominal tergites of the female often

guttate with fuscous, those of the male black, the posterior margins narrowly yellowish. Elytra of the female grayish hyaline, an oblique transverse band crossing near the middle, interrupted at the claval suture; and another, transverse, just before the apex; veins concolorous. Elytra of the males fuscohyaline, immaculate. Wings of the female pale smoky hyaline, veins fuscous; those of the male smoky, the veins concolorous.

A considerable number of specimens taken in Maine, Pennsylvania, Wisconsin, Minnesota, South Dakota, Colorado, and the type from Muskoka, Ontario, were examined in the preparation of this description. Van Duzee (11) also records this species from Quebec, New York, and Iowa. The Iowa record seems to be on the authority of Osborn and Ball. The reasons for considering this an error are given in the discussion of the synonymy of *nigricans* Van D.

Host: Poplar, *Populus* sp., probably *tremuloides* Michx.

Location of type: Iowa State College, Ames.

Macropsis tristis (Van D.).

Pediopsis tristis Van D., Can. Ent., xxii, p. 249, 1890.

Cinereous-brown above, yellowish-green below; face with a black band above and a large black spot below; veins of the elytra strong, light in color and narrowly margined with fuscous. Length: female, 5.5 mm., male, 4.75 mm.; width: female, 2 mm., male, 1.8 mm.

Pronotum right-angled before, scarcely convex, anterior impressions as long as the long diameter of the eye; rugae very coarse and strongly oblique, median line present; posterior margin with a rather deep angulate sinus. Rugae and punctures of the face coarse, punctures next the eye very coarse. Clypeus rather narrow, longer than the basal width, the sides straight and converging toward the broadly rounded much depressed apex. Lorae very broad, each as broad, horizontally, as the clypeus, tumid. Scutellum coarsely punctate on the disc. Elytra very broad and long, broadly rounded at the apex, the veins strong.

Color: Pronotum cinereous, the anterior impressions and between the rugae fuscous. Scutellum cinereous, fuscopunctate, a black triangle within either basal angle. Face cinereous, a band extending across the superior margin, running down to a point near the middle and emphasized as spots above the ocelli, and a large circular spot below, black. Beneath yellowish-green, epimera slightly fuscous, episternal and triangular pieces piceous, legs mottled and striped with fuscous. Elytra cinereous hyaline, the veins pale, evenly and narrowly margined with fuscous. Wings pale smoky hyaline, the veins fuscous.

Specimens from Ohio, Illinois, Iowa, Missouri, Kansas, and Colorado are before the writer. Van Duzee (11) also records the species from Pennsylvania. The Iowa series contains two cotype specimens.

Host: Wild plum, *Prunus* sp., probably *americana* Marsh.

Location of types: Collections of Herbert Osborn and Iowa State College, Ames.

Nymphs: The writer found this species developing in a plum thicket in Ashtabula County, Ohio, in June, 1931. The nymphs are stout and depressed, with transverse head, the abdomen broad and flattened, lacking the crest of the nymphs of *viridis* Fitch. They are colored in general imitation of the adult: reddish-brown, marked with white along the sutures, with four light spots on the thorax arranged in the form of a square, the face bearing a large black spot as in the adult, the body clothed with fine white hairs which produce a light reflection. Structurally these nymphs bear a striking resemblance to those of certain Membracids.

Macropsis robusta sp. n.

Robust in appearance; castaneous to greenish-fulvous in color; face, pronotum, and scutellum fuscopunctate. Length: female, 5 mm., male, 4.5 mm.; width: female, 2 mm., male, 1.6 mm.

Pronotum broadly obtuse-angled before, moderately convex; coarsely and deeply crenulate punctate, median line usually present, anterior impressions shorter than the long diameter of the eye; posterior margin bearing a deep angulate sinus. Face nearly flat when viewed from the side, thickly set with rather coarse and deep punctures. Clypeus of the female broader at the base than long, sides straight and converging rapidly toward the narrowly rounded depressed apex; that of the male basally, together with the apex of the front, strongly tumid, the sides bulging out over the lorae. Lorae of the female broad and tumid, those of the male nearly hidden, reduced to mere lines. Scutellum deeply punctate on the disc. Elytra subcoriaceous, coarsely punctured, broad and rather short, broadly rounded at the apex, the veins weak.

Color: Castaneous to greenish-fulvous. Face fulvous, thickly fuscopunctate. Beneath pale greenish-yellow, nearly immaculate, pleural pieces somewhat stained with fuscous. Pronotum fulvous, coarsely fuscopunctate. Scutellum fulvous, fuscopunctate on the disc, basal angles castaneous, a pair of large round yellowish spots just anterior to the extremities of the transverse impression. Elytra castaneous, pellucid, the veins concolorous. Dorsal surface of abdomen fuscous,

the posterior margins of the segments narrowly yellowish, eighth segment of female usually entirely pale. Wings whitish hyaline, the veins smoky.

Description based on nine specimens, one male and eight females: Holotype, female, Cranberry Lake, New York, July 20, 1917, C. J. Drake collector; allotype, male, same data, in the collection of Herbert Osborn. Paratypes: Saddleback Lake, Maine, July 18–20, 1916, Herbert Osborn collector; Orono, Maine, July 2, 1913, Herbert Osborn collector; Sault Saint Marie, Canada, July–August, 1904, also in the collection of Herbert Osborn. Paratype, Charter Oak, Pennsylvania, June 18, 1918, J. N. Knull collector, in the collection of D. M. De Long. Paratypes: Sault Saint Marie, Canada, July–August, 1904, and Highmoor, Maine, August 15, 1913, Herbert Osborn collector, in the U. S. National Museum. Paratype, Orono, Maine, July 3, 1914, Herbert Osborn collector, in the author's collection.

Host: Unknown.

Macropsis basalis (Van D.).

Pediopsis basalis Van D., Ent. Am., v, p. 171, 1889.

Robust in form; head and thorax of female ferruginous above, greenish below and posteriorly, a broad black band on the bases of the elytra bordering the scutellum and often more or less distinctly twice banded with fuscous in addition; male smoky ferruginous, elytra dark amber, black basally as in the female. Length: female, 5 mm., male, 4–4.25 mm.; width: female, 1.75 mm., male, 1.3 mm.

Pronotum parabolically obtuse-angled before, moderately convex, anterior impressions scarcely as long as the long diameter of the eye; rugae fine and indistinct, reticulate, those of the male coarser, appearing more as deep punctures, median line indicated; posterior margin with a shallow angulate incision. Face somewhat tumid when viewed from the side, rugae and punctures indistinct. Clypeus of the female nearly as broad as long, sides converging toward the broadly rounded apex which is depressed slightly on the narrow submargins before the lorae, the sutures distinct; that of the male, basally, together with the apex of the front, tumid, the sides bulging out over the lorae, the sutures obsolete. Lorae of the female tumid and prominent, those of the male very much reduced and inconspicuous. Scutellum finely punctate on the disc. Elytra broad and long, broadly rounded at the apex, the veins weak.

Color: Female olive green, upper part of face, pronotum, and scutellum ferruginous. Elytra greenish hyaline, a broad black band

in the base of the clavus margining the scutellum and often more or less distinctly twice banded with fuscous in addition. Beneath greenish, immaculate, the epimera unmarked. Male smoky ferruginous. Elytra dark amber, black basally as in the female. Vertex and pronotum fuscopunctate, scutellum fuscopunctate on the disc, a brown triangle within either basal angle. Beneath yellowish-green, immaculate except for the large sooty-black spots with which the epimera are marked.

Specimens from Maine, New Hampshire, New York, Pennsylvania, Michigan, Ohio, Wisconsin, Minnesota, Idaho, Utah, Ontario, and British Columbia are at hand for the preparation of this description. The Ontario specimen is the type from Muskoka Lake. Van Duzee (11) also records the species from Quebec, Iowa, and Colorado. The Iowa record is apparently on the authority of Osborn and Ball. Specimens of the insect which they secured from cottonwood at Ames are before the writer and represent a species described here as new, namely, *osborni* sp. n.

As pointed out by Osborn and Ball, the differences in the coloration of the elytra of the females seems to be due to a localization of the pigment, the basal band becoming darker as the brown disappears from the remainder of the elytra. The males exhibit no such variation in coloration. It would be difficult to separate the males from those of similar appearance were it not for the very broad clypeus and its characteristic shape. The writer was fortunate enough to collect a good series of both males and females of this species, some in copula, from an isolated stand of quaking aspen in a marsh meadow near Hudson, Ohio, during the summer of 1931. Thus males of known identity were secured; and upon learning their peculiarities, it has been possible to recognize them in other collections.

Host: Quaking Aspen, *Populus tremuloides* Michx.

Location of type: Iowa State College, Ames.

Macropsis fumipennis (G. & B.).

Pediopsis fumipennis Gill. & Bak., Hemip. Colo., p. 73, 1895.
Pediopsis crocea O. & B., Proc. Dav. Acad. Nat. Sci., vii, p. 68, 1898.

Green or yellowish-green, pronotum and scutellum tinged with smoky-brown, elytra deep smoky-brown, the costal margin greenish, epimera unmarked. Length: female, 4.75 mm., male, 4–4.25 mm.; width: female, 1.5 mm., male, 1.5 mm.

Pronotum parabolically obtuse-angled before, strongly convex, anterior impressions as long as the long diameter of the eye; rugae coarse, reticulate, median line present; posterior margin with a deep

ovoid incision. Face slightly tumid when viewed from the side, rugae and punctures fine and indistinct. Clypeus of the female broad, as broad at the base as long, sides straight on the basal two-thirds, converging slightly toward the rounded apex; that of the male, together with the lower part of the front, tumid, blending imperceptibly into the front, the sides bulging out over the lorae, nearly obscuring them. Lorae of the female tumid, prominent, those of the male reduced to mere lines. Scutellum coarsely punctate on the disc, basal angles shagreened, apical angle longitudinally and coarsely rugose. Elytra strong, broad and moderately long, broadly rounded at the apex, the veins weak.

Color: Nearly black above, costa broadly yellowish-green; beneath, yellowish-green, immaculate, epimera unmarked. Pronotum yellowish-green, clouded with fuscous on the disc, anterior impressions immaculate. Disc of scutellum heavily fuscopunctate, enlivened with greenish or yellowish, two large round impressed greenish or yellowish spots just anterior to the transverse impression, the basal triangles piceous. Elytra blackish or brownish-black, nearly opaque, changing to greenish or yellowish-green along the costa. Wings smoky, the veins fuscous.

The above description is based on a large series of specimens from Ohio and Kentucky. The Kentucky specimens are eight of the types of *crocea* O. & B. The writer had suspected that *crocea* O. & B. was the same species as *fumipennis* G. & B., so he sent specimens which he had determined as *crocea* to Washington, D. C. with Dr. Herbert Osborn, who was kind enough to compare them with the type of *fumipennis* in the National Museum. Dr. Osborn states that these specimens agree with the type of *fumipennis;* and since they are indistinguishable from the types of *crocea*, *fumipennis* G. & B. must be the same species as *crocea* O. & B. As a result of these studies the writer has decided to treat *gleditschiae* O. & B. as a color variety of *fumipennis*, since no morphological basis for separating them can be found. Numerous collections made from the Honey Locust in Ohio have brought to light only a few female specimens of the lighter phase.

Host: Honey Locust, *Gleditschia tricanthos* L.

Location of type: U. S. National Museum, Washington.

Nymphs: The nymphs are green, more or less overcast with fuscous, resembling those of *viridis* Fitch, and exhibiting their generic characteristics in the earliest instars. They are short and stout, with transverse head, convex thorax, and broad crested abdomen, each segment of which is elevated into a flat curved tooth projecting backward and tipped with a hair. The coloring of this insect is admirably suited to that of the

host plant, enabling it to blend nicely into its background, thus providing concealment. The leafhoppers are usually found on the leaf stalks and on the smaller branches.

Macropsis fumipennis var. **gleditschiae** (O. & B.).

Pediopsis gleditschiae Osb. & Ball, Proc. Dav. Acad. Nat. Sci., vii, p. 68, 1898.

Differs from *fumipennis* G. & B. only in its lighter color, being almost uniformly yellowish-green, the elytra somewhat smoky, especially in the males.

Morphologically, this form seems to differ not at all from *fumipennis*.

Color: Female bright green, more or less overcast with fuscous, elytra hyaline apically. Males green, the elytra clouded with brownish or fuscous. Pronotum and scutellum often clouded with fuscous in darker specimens. Epimera unmarked in either sex.

Specimens before the writer are from Iowa, Tennessee, Louisiana, Nebraska, Kansas, and Idaho. The Iowa series includes a considerable number of the types. These insects vary considerably in the amount of smokiness or fuscous coloring matter present. The Louisiana specimens, males and females, Baker Collection, U. S. National Museum, C. R. Pilate collector, are from Opelousas. They are slightly smaller than the Iowa types, though otherwise indistinguishable. Both males and females are of the same shade of green with the same amount of fuscous overcasting. In the absence of host data, it is thought best to place them here. The Idaho specimens, a large series from near Twin Falls, D. M. De Long collector, have been placed here. Structurally, they are very close to the types, but are somewhat darker in color and distinctly yellow where the types are green. They were collected in the canyon immediately above Shoshone Falls. In the absence of host data it is impossible to more accurately place them at this time. Van Duzee (11) also records *gleditschiae* from Pennsylvania and Missouri.

Host: Honey Locust, *Gleditschia tricanthos* L.

Location of types: Collections of Herbert Osborn, E. D. Ball, and Iowa State College, Ames.

Macropsis confusa sp. n.

Resembles *viridis* Fitch with which it has been confused, but smaller and of a different form and coloration; both male

and female lactean-green, immaculate, the elytra faintly smoky. Length: female, 4.75 mm., male, 4 mm.; width: female, 1.45 mm., male, 1.35 mm.

Pronotum obtuse-angled before, moderately convex, anterior impressions shorter than the long diameter of the eye; rugae very fine and indistinct, finer than those of *viridis*, median line obsolete; posterior margin with a shallow angulate incision. Face distinctly tumid when viewed from the side, rugae and punctures nearly obsolete. Clypeus of the female a little broader at the base than long, the sides nearly straight and converging rapidly toward the broadly rounded apex, the entire clypeus having the appearance of having been depressed between the lorae and anterior coxal pieces; that of the male but slightly swollen and merging imperceptibly with the front, the sides deviating immediately from the apex, almost obliterating the lorae. Lorae of the female tumid and shiny, those of the male reduced to mere lines. Scutellum impunctate on the disc. Elytra broad and short, acutely rounded at the apex, the veins weak.

Color: Both male and female are pale lactean-green, immaculate, the elytra faintly smoky. Wings whitish hyaline, the veins concolorous.

Description based on seventeen specimens, one male and sixteen females. Holotype, female, Greenfield, Pennsylvania, July 20, 1920, D. M. De Long collector, and allotype, same data, in the collection of D. M. De Long. Two paratypes, Charter Oak, Pennsylvania, J. N. Knull collector, one on July 8, 1919, and the other July 5, 1920, also in the collection of D. M. De Long. Eight paratypes, Orono, Maine, July 28, 1913, Herbert Osborn collector, all taken from poplar and one so labelled, four in the collection of Herbert Osborn, two in the U. S. National Museum, and two in the author's collection. Four paratypes, Cranberry Lake, New York, July 20, 1920, Herbert Osborn collector, all labelled "Populus", in the collection of Herbert Osborn. Paratype, Fish Creek, Wisconsin, August 14–24, 1926, Paul B. Lawson collector, in the collections of the University of Kansas.

Host: Poplar, *Populus* sp., probably *tremuloides* Michx.

Macropsis trimaculata (Fitch).

Pediopsis trimaculatus Fitch, Homop. N. Y. State Cab., p. 60, 1851.
Pediopsis trimaculatus O. & B., Proc. Dav. Acad. Nat. Sci., vii, p. 116, 1898.

Fuscotestaceous, the males nearly black, three pellucid white spots in a row on each elytron, clavus cinereous. Length: female, 5 mm., male, 4.5 mm.; width: female, 1.75 mm., male, 1.5 mm.

Pronotum parabolically obtuse-angled before, anterior impressions shorter than the long diameter of the eye; rugae strongly oblique, distinct though fine, median line wanting; posterior margin deeply incised. Face scarcely tumid when viewed from the side, plainly and evenly punctate, rugae distinct above. Clypeus narrow, longer than the basal width, the sides straight and parallel to the truncate and depressed apex. Lorae broad, strongly tumid. Scutellum finely punctate on the disc. Elytra short, roundingly truncate, coriaceous in texture, veins weak. Genitalia: Oedagus of the male flaringly bifurcate at the apex. Last ventral segment of the female triangular, notched at the apex.

Color: Fuscotestaceous, the males nearly black. Face somewhat lighter, fuscopunctate, superior tip and apex darker, that of the male surrounded with a whitish halo. Lorae paler, yellowish. Beneath infuscated, the male nearly black, the margins of the segments lighter. Epimera each bearing a black bar which is nearly obscured in the male by the impigmentation. Episternal pieces heavily stained with fuscous. Pronotum of the female testaceous, a dusky patch on the disc; that of the male fuscous, overcast with cinereous. Scutellum cinereous, fuscopunctate, a dark triangle within either basal angle. Elytra with a pellucid white spot within the third and fourth apical cells, a larger one at the jucture of the anteapical and basal cells, and a third near the branching of the first sector; veins pale, clavus cinereous. Wings smoky hyaline, veins fuscous.

The above description is based on numerous specimens from Colorado, Iowa, Illinois, Minnesota, Wisconsin, Michigan, Ohio, Pennsylvania, New York, Ontario, and Maine. This species has been confused with Van Duzee's *insignis*, the description of which follows, together with a discussion of the synonymy that has arisen. This is the insect Osborn and Ball had before them. However, they failed to recognize a few specimens of *insignis* which were also before them, though much in the minority.

Host: Wild plum, *Prunus* sp., probably *americana* Marsh. It frequently occurs along with *insignis* although either may, and does often, occur alone in a given situation.

Location of type: If not lost, the type should be in the Fitch Collection at the New York State Museum, Albany.

Nymphs: The nymphs are robust in form, with short transverse head, convex pronotum, and broad abdomen in keeping with other species of the genus. However, they belong to that group in which the abdomen is lifted into a sharp crest, each segment of which ends in a well defined tooth which projects backward. In such characters they differ markedly

from the nymphs of *tristis* Van D. Their coloration is a reddish-brown, contrastingly marked with fulvous and quite freely fuscopunctate. Pronotum medially fulvous. Basal angles of the scutellum blackish, a broad fulvous vitta contiguous to the scutellar region, and a second just caudad and paralleling it. Wing pads mostly yellowish-green. Seventh, eighth, and ninth abdominal tergites fulvous near the crest, the teeth black; and usually a fulvous vitta arises on either side of the abdomen near the origin of the second pair of wing pads and widens posteriorly, ending on the lateral margins of the seventh and eighth tergites. Face dark brown, clypeus and beneath yellowish, thoracic pleurites blackish, legs yellowish, striped with blackish, genital pieces infuscated. Nymphs on which this description is based were taken from wild plum in Ashtabula County, Ohio, in June, 1931.

Macropsis insignis (Van D.).

Pediopsis insignis Van D., Ent. Am., v, p. 171, 1889.

Fuscoferruginous, resembling *trimaculata* Fitch with which it has been confused, but lighter in color and having only one pellucid white spot on each elytron and that usually obsolete in the male. Length: female, 5 mm., male, 4.25 mm.; width: female, 1.75 mm., male, 1.5 mm.

Pronotum parabolically obtuse-angled before, anterior impressions shorter than the long diameter of the eye; rugae fine, strongly oblique, median line often wanting; posterior margin deeply and roundingly arcuated. Face moderately tumid when viewed from the side, rugae and punctures distinct. Clypeus much longer than broad, sides straight and parallel to the broadly rounded apex which is scarcely depressed. Lorae broad, somewhat tumid, not so tumid as those of *trimaculata*, thick, almost coriaceous in texture, veins weak. Genitalia: Oedagus of male stylate. Last ventral segment of the female broad, triangular, notched at the apex.

Color: Fuscoferruginous, covered with a distinct pruinosity when freshly collected, the males somewhat darker. Face and beneath brownish-fulvous, superior tip and apex somewhat darker. Lorae pale, yellowish. Epimeron with a small brown dot, and a brown spot occupying the lower half of the episternum. Abdomen of the male blackish above, the margins of the segments paler. Pronotum ochraceous, a dusky patch on the disc with a curved extension on each side along the posterior margin toward the humeral angles. Scutellum ochraceous with a fuscous triangle within either basal angle. Elytra uniformly fuscoferruginous, or slightly paler apically along the costa,

opaque except for a pellucid spot on the bases of the two inner anteapical cells, veins pale. The elytra of the males are concolorous except for the somewhat paler veins. Wings fuscohyaline, the veins darker.

Specimens from Pennsylvania, New York, Ontario, Ohio, Wisconsin, Minnesota, Iowa, Kansas, South Dakota, and Colorado were examined in the preparation of the above description. The New York material included one cotype specimen.

Host: Wild plum, *Prunus* sp., probably *americana* Marsh. This species often occurs along with *trimaculata* Fitch. The writer took both species from a plum thicket near Brookville, Pennsylvania, in the summer of 1931 and again in Ashtabula County, Ohio. However, a large number of specimens were swept from a plum thicket near Racine, Wisconsin, and not a *trimaculata* among them.

Location of types: Collection of Herbert Osborn and Iowa State College, Ames.

Nymphs: The nymphs are of the same form as those of *trimaculata*, but are uniformly ferruginous in color, lacking the fulvous or yellowish markings of that species. Freshly collected specimens are covered with a pruinosity which, together with their color, renders their presence on the younger branches of the host plant quite indistinguishable.

When studying the specimens that had been swept from a plum thicket near Brookville, Pennsylvania, it was found that they fell into two rather distinct groups. Furthermore, it was found that Fitch had enumerated those characters in preparing his description of *trimaculata* which were the most obvious and at the same time the most characteristic of one of these groups. The second group was checked against Van Duzee's description of *insignis* and led to the conclusion that Van Duzee must have had this insect before him. It is probable that Van Duzee may have had specimens of *trimaculata* before him also. In fact, one suspects that he did from the wording of his description in places. However, no mention is made of more than one spot on each elytron; and when the insects of this second group were compared with a cotype specimen of *insignis*, they proved to be of the same species. As a final check the male genitalia were examined and left no doubt as to the two groups belonging to different species. The oedagus of the male of *trimaculata* is flaringly bifurcate while that of *insignis* is stylate.

Macropsis quadrimaculata sp. n.

Fulvous to reddish-brown, the pronotum acute-angled before, each elytron bearing two white spots, one on the corium and one in the base of the clavus. Length: female, 4.5 mm., male, 4 mm.; width: 1.5 mm.

Pronotum a little less than right-angled before, strongly convex, anterior impressions shorter than the long diameter of the eye; rugae coarse and distinct over the entire surface, strongly oblique, median line indicated; posterior margin bearing a rather deep angulate incision. Face but slightly tumid when viewed from the side, rugae and punctures coarse and shallow. Clypeus very small and narrow, the sides straight and converging somewhat toward the strongly depressed truncate apex. Lorae of both sexes very broad, each as broad horizontally as the width of the clypeus, strongly tumid. Scutellum finely punctate on the disc. Elytra coriaceous, short and broadly rounded at the apex, veins weak. Genitalia: Oedagus of the male stout, somewhat fundibulate at the apex. Last ventral segment of the female keystone-shaped, a shallow semicircular notch in the posterior margin.

Color: Fulvous to reddish-brown. Pronotum fulvous, immaculate. Face and beneath fulvous, immaculate except for the fuscous stains on the epimera and episternal pieces which are not always present. Scutellum fulvous, a fuscous triangle within either basal angle. Elytra reddish-brown, opaque, a pellucid white spot anteriorly on the clavus near the point of articulation, and a second posteriorly on the corium, occupying in part the bases of the anteapical cells. Wings whitish hyaline, the veins fuscous.

Six specimens are before the writer: Holotype, female, Hot Springs, South Dakota, August 27, 1922, H. C. Severin collector, and allotype, male, same data, in the collection of D. M. De Long; paratype, female, Capa, South Dakota, September 24, 1920, H. C. Severin collector, in the author's collection; paratypes: male, Sioux County, Nebraska, August, 1903, and female, Swannanoa, North Carolina, August 23, 1919, Herbert Osborn collector, in the collection of Herbert Osborn; and paratype, female, Carl F. Baker Collection, "Colo. 1593," U. S. National Museum, in the National Museum.

Host: Raspberry, *Rubus* sp.? The holotype and allotype specimens bear the host label "Raspberry." If further studies reveal that *Rubus* is indeed the host of this distinctive species, it will be the first nearctic species known to live on plants other than those classed as trees.

SYNOPTIC TREATMENT OF THE SPECIES.

The following is an attempt to arrange the nearctic species according to their apparent affinities. For the majority of cases, these tend to arrange themselves into rather well defined groups as regards structure and form. As a rule, the groups seem to differ more from one another than the species do within any one group.

Nubila group: At the present time *nubila* Van D. is the sole representative of this group. The reticulate venation of the elytra and the lack of any very definite arrangement in the rugose puncturing of the pronotum are indicative of its uniqueness.

Punctifrons group: *Gerhardi* sp. n. and *punctifrons* Van D. have been placed here. Both are small with characteristic form and appearance. The veins of the elytra of *punctifrons* are contrastingly dark while those of *gerhardi* are outlined by heavy stippling. In place of the spots found on the face of *punctifrons*, the face of *gerhardi* is thickly set with prominent black impressed points.

Virescens group: These two palaearctic species, *virescens* Gmel. and *ulmi* Scott, have been placed here. Both species have the pronotum acute-angled before, the rugae strongly oblique, and the hind tibiae each bear a prominent black spot on the outside near the base.

Reversalis group: *Reversalis* O. & B. and *trivialis* Ball represent this group. Both males and females are green, the males only being marked with black. Each male has the extremities of the fore, and sometimes the middle tibiae, the tarsi, and usually the epimera, marked with black.

Viridis group: The *viridis* group contains three species: *viridis* Fitch, *hesperia* sp. n., and *occidentalis* Van D. The females are greenish and unmarked except for the black spots on the epimera of *occidentalis*. In contrast, the elytra of the males are some shade of amber, and the abdomen is distinctly fulvous in contrast with the greenish head and thorax.

Suturalis group: *Suturalis* O. & B., *bicolor* Osb., *sordida* Van D., *canadensis* Van D., and *rufocephala* Osb. have been placed here in the order given. The color pattern of the male is essentially that of the female. The blackish sutural stripe of *suturalis* can be thought of as spreading over and occupying the entire upper part of *bicolor*, breaking up in *sordida* and beginning to differentiate into transverse bands which reach their final development in *canadensis*. The dark coloring has disappeared from the elytra of *rufocephala*, remaining only on the upper part of the head and thorax.

Ferruginoides group: *Ferruginoides* Van D. and *erythrocephala* G. & B. represent a distinct group. The pronotum is strongly angulate before, and the face is concave just below the vertex. Both males and females have essentially the same color pattern. The rusty brown coloring of *ferruginoides* appears to have almost vanished from *erythro-*

cephala, remaining to enliven the upper part of the head and thorax of some females, and persisting to a greater extent in some males.

Pallida group: Two species have been placed here: *cinerea* sp. n. and *pallida* sp. n. Both have a characteristic form and appearance, the elytra are nearly hyaline, and the epimera of the females are marked with prominent black spots.

Aurifera group: *Delongi* sp. n., *aurifera* sp. n., and *osborni* sp. n. have been placed here. The golden amber of the elytra of *aurifera* seems to have become concentrated in the basal halves of the claval areas of *osborni*, resulting in a blackish basal band. None of the females of this division have the epimera marked with black.

Nigricans group: *Nigricans* Van D., *bifasciata* Van D., and *tristis* Van D. constitute a rather well defined group. This is especially evident when the nymphs of this division are compared with those of others. The abdominal crest is scarcely developed in the nymphs of these species.

Robusta group: Two species, *robusta* sp. n. and *basalis* Van D., have been placed here. Both have a characteristic form and appearance. The head and thorax are fuscopunctate, and the pigment of the elytra of *robusta* might be said to have become concentrated in the bases of the claval areas of *basalis*.

Fumipennis group: This group takes in *fumipennis* G. & B. and *confusa* sp. n. Both the males and females of these species are similarily colored and have the epimera unmarked. The intense smoky-brown of the elytra of *fumipennis*, much reduced in var. *gleditschiae* O. & B., appears to remain as only a slight smokiness apically on the elytra of *confusa*.

Trimaculata group: *Trimaculata* Fitch, *insignis* Van D., and *quadrimaculata* sp. n. constitute a well defined group. The rugae on the pronotum of each are strongly oblique, the elytra are short and nearly coriaceous in texture, and each elytron is marked with from one to three round pellucid white spots. This is the only group in which the male genitalia present useful specific characters.

CONFUSING SPECIES.

Osborn and Ball (9) have pointed out some of the difficulties encountered in attempting to place the species belonging to this group. After several years of rather intensive work with the genus, the writer finds himself in perfect accord with their statement that it is one of the most difficult genera of the family in which to define species. However, with more material at hand than they possessed, representing many additional localities, and with their excellent work as a basis from which to proceed, the writer has reached the conclusion that many of the variations which were thought to exist were really due to a confusion of species.

Van Duzee had similar experiences in his earlier work. In the series of specimens which he had before him when describing his *sordida*, there are no less than three species. These very nicely account for the exceptions he mentions. It is to his credit, however, that he did not place type labels on any of the exceptions. Osborn and Ball had a fine series of *nigricans* Van D. for study, unnamed at that time, which they called *bifasciata* Van D. even though they had the type of *bifasciata* before them for comparison. One suspects that Van Duzee's confusion as to the identity of *trimaculata* Fitch was a contributing factor. Also, the insect which Osborn and Ball treated as *basalis* Van D. was an unnamed species, *osborni* sp. n. As in the case of *bifasciata*, they had the type of *basalis* before them for comparison. *Viridis* Fitch has frequently been confused with *trivialis* Ball and *confusa* sp. n.; and in much the same way, *sordida* has been confused with dirty and discolored specimens of *viridis*, and with *robusta* sp. n. Van Duzee's *insignis* has been confused with Fitch's *trimaculata*, and less frequently, *rufocephala* Osb. with *erythrocephala* of Gillette and Baker.

As our knowledge of the leafhoppers belonging to this group accumulates, it becomes increasingly evident that the species are less variable than formerly supposed. Both the nymphs and adults are quite definite in their color pattern; and each species seems to be restricted as to food plant.

LIFE HISTORY.

All nearctic species of *Macropsis* whose life histories are known show a great similarity in their seasonal development. Because of this similarity, the seasonal development of the various species will be summarized here. There is but one generation each year, winter being passed in the egg stage, the nymphs appearing in May in this region, and reaching maturity by the middle of June. Males issue as adults first, preceding the females by several days to a week. The adult life of the male is limited to about two weeks, that of the female being much longer. Females are present well into July and are often taken well into August. Oviposition doubtless extends over a period of several weeks. The eggs are inserted singly just beneath the bark tissue of two year old wood, usually in the vicinity of buds near the terminus of growth. The bark over

the egg is raised and the tissue around the egg is usually somewhat discolored. The very young nymphs feed on the unfolding leaves and leaf petioles. As they become older they take up positions on the stems in the axils of the leaves, where their resemblance to buds must afford them protection.

As exceptions to the above generalization, we find the plum inhabiting species, *trimaculata* Fitch, *insignis* Van D., and *tristis* Van D. not reaching maturity until early in July.

Each species known to us is tree inhabiting, with the possible exception of *quadrimaculata* sp. n., which has been reported from raspberry, *Rubus* sp. Of the thirty-two species treated in this paper, thirteen are quite definitely known to breed on *Salix*, five on *Populus*, three on *Prunus*, one on *Gleditschia*, and one on *Rubus*. It will be noted that the majority of palaearctic species are likewise known to breed on *Salix*. Does this mean that *Salix* is the original host of the genus? As additional evidence pointing to *Salix* as the original host, we find the next greatest number breeding on the closely related *Populus*. To attempt to account for the few species which are known to breed on quite distantly related trees is another matter.

ECOLOGICAL NOTES.

The present status of our knowledge concerning these leafhoppers indicates that the natural range of the host tree determines the distribution of the insect. In a broad sense, the ecological conditions which favor the development of the host tree also tend to insure the presence of the insect that is dependent upon it for food and shelter. More specifically however, certain species have achieved niceties of adaptation to their immediate surroundings which are worthy of note.

Perhaps the most obvious of these adaptations are colorations which afford both nymphs and adults concealment while at rest on the host. Both the nymphs and adults of *insignis* Van D. are covered with a pruinosity that, together with the natural color of the insect, enables them to blend nicely into the background afforded by the branches of the plum tree on which they rest. The nymphs of *tristis* Van D., which are found on the same host, are covered with fine white hairs which produce a similar effect to the pruinosity of *insignis*. Similarly, the smoky or fuscous overcasting of the green bodied *fumipennis* G. & B. aids in its concealment. Both the nymphs and adults

are so colored, and are found on the leaf stalks and younger branches of the Honey Locust which are bright green with more or less of the same smoky overcasting. The coloration of both the nymphs and adults of *nigricans* Van D. affords them protection. As stated elsewhere, the nymphs are found in or near the axils of the leaves of the cottonwood where their shape and coloration favor their concealment. When resting beside a bud in the axil of a leaf, only sharp and well trained eyes can detect their presence. The examples cited are those best known to the writer. The adaptations of *viridis* Fitch and *ferruginoides* Van D. and others are no less interesting.

Of equal advantage, though not so evident, is the extent to which these insects seem to "rely" on the effectiveness of their protective coloring. While studying the nymphs of *nigricans*, it was noted that ordinary provocation failed to cause them to shift their positions. After sufficient provocation they would move, but instead of leaping for safety, usually dodged around to the opposite side of the branch from their tormentor. This behavior is quite typical of the nymphs of these leafhoppers, and so tenaceously do they cling to their position that sweeping is a poor way to collect them.

HOST RESTRICTION.

The writer's studies, which are in keeping with those of others, indicate that each species will prove to be quite definitely restricted to a particular host tree during its developmental period. The development of the insect is also very nicely adjusted to certain stages in the seasonal development of the host tree. It has been suggested to the writer that this host selection may be determined by the presence of some glucoside such as *salacin*. As evidence purporting to sustain this suggestion, it is known that *salacin*, while common to a great many willows and to most poplars, has not been shown to be present in all; and one experienced in collecting these leafhoppers knows that in a mixed willow thicket he will find a certain species of *Macropsis* occurring in numbers on one variety, while its neighbors may be practically free of the insects. Likewise, the developmental period of the insect's life cycle may be adjusted, in part, to suit the availability of such a substance. It is known, for example, that *salacin* is abundant in the growing parts of the tree in the early spring, the supply gradually dropping off as the season advances, until by fall

there is relatively much more of the substance in the cortex of the stem. An investigation of such possibilities would doubtless lead to most interesting results.

FAUNISTIC RELATIONSHIPS.

The nearctic species of *Macropsis* as a group differ greatly from their palaearctic relatives in several rather striking characters. All palaearctic species which the writer has examined have a prominent black spot on the outside near the base of each hind tibia. Edwards (4) records eleven species for the British Isles, ten of which are described as having such a mark. Of the thirty species known to belong to the nearctic fauna, not one has even the suggestion of such a mark. The two palaearctic species, *virescens* Gmel., and its varieties, and *ulmi* Scott, which have become established here, both have this mark.

All nearctic species, with the exception of *punctifrons* Van D., have the veins of the elytra concolorous with the remainder of the elytra. In contrast to this, dark veins which are not concolorous with the rest of the elytra are the rule among palaearctic species. Among the nearctic species, three are known to have definite spots on the face: *tristis* Van D., *punctifrons* Van D., and *reversalis* O. & B. Of these, only *punctifrons* has the spotting characteristic of so many palaearctic species, namely, an irregular spot at the apex of the vertex, a round spot above each ocellus, and a pair of parenthesis-like spots on the upper part of the front, five in all.

Following his original description of *occidentalis*, Van Duzee discusses at length his reasons for considering his new species a connecting link between the two faunae. In the light of our accumulating knowledge of these leafhoppers, the writer considers that *punctifrons* is closer to the palaearctic fauna than any other. It has the typical spotting of the face and the dark contrasting veins of the elytra. So far it is known only from Arizona, a locality which places it in a faunal subdivision that is generally conceded to be more nearly related to the palaearctic than any other.

GEOGRAPHICAL DISTRIBUTION.

About eighty species of *Macropsis* have been described from all over the world. The genus is best known from the North

Temperate Zone. This is perhaps due to the greater amount of work which has been done on the faunae of these regions. China (2) includes ten species in his monograph of the Ethiopian species, most of which are known from South Africa. Kirkaldy (7) also records four from Australia and Dozier (3) one from Santo Domingo. It is evident that the African and Australian species are more closely related to the palaearctic fauna than to the nearctic.

The nearctic species are most numerous in the Transition and Upper Austral Zones of the Austral Region.* As pointed out elsewhere, the range of each species seems to be largely determined by the natural distribution of its host tree.

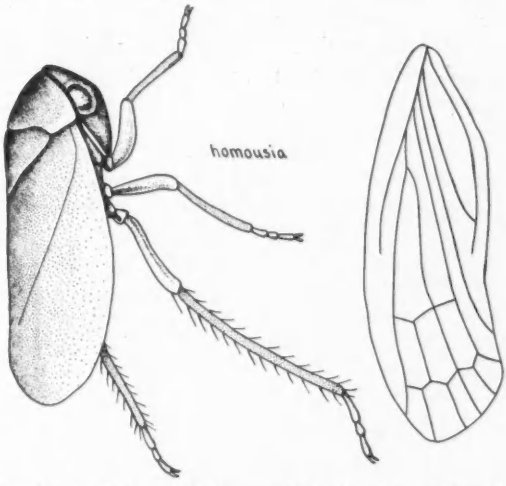

FIG. 3. *Macropsis homousia* (Germ. & Ber.), redrawn after Germar and Berendt.

GEOLOGICAL HISTORY.

Germar and Berendt (5) have described and figured a *Macropsis* from Baltic amber, whose fossil seems to be in an exceptionally fine state of preservation. An examination of the figure of this insect, *Macropsis* (*Bythoscopus*) *homousia*, leads to the conclusion that these leafhoppers of the Oligocene epoch of the Tertiary differed little from their posterity. (Fig. 3).

*Merriam, C. Hart, Life Zones and Crop Zones of the United States, U. S. Dept. Agr., Bull. 10, Div. Biol. Surv., 1898.

Such a high degree of development at that time indicates that they had been present on the earth a much greater length of time. The close association between these insects and the willows, *Salix* spp., and their near relatives the poplars, *Populus* spp., has been discussed. These trees have been traced back into the Cretaceous in an unbroken line. They were world wide in distribution then, and have been very much so since. It is possible that these insects became associated with their host trees somewhere near the time when they were becoming differentiated as a component part of the earth's flora. Amber is generally credited with being the petrified gum of a conifer, especially that of the spruce, *Picea susinifera*. It is common knowledge that willows, poplars, and spruce are often found flourishing in the same locality. Such a situation would favor the trapping of the various leafhoppers which feed on the willows or poplars in the gum exuded by the spruce and their subsequent preservation.

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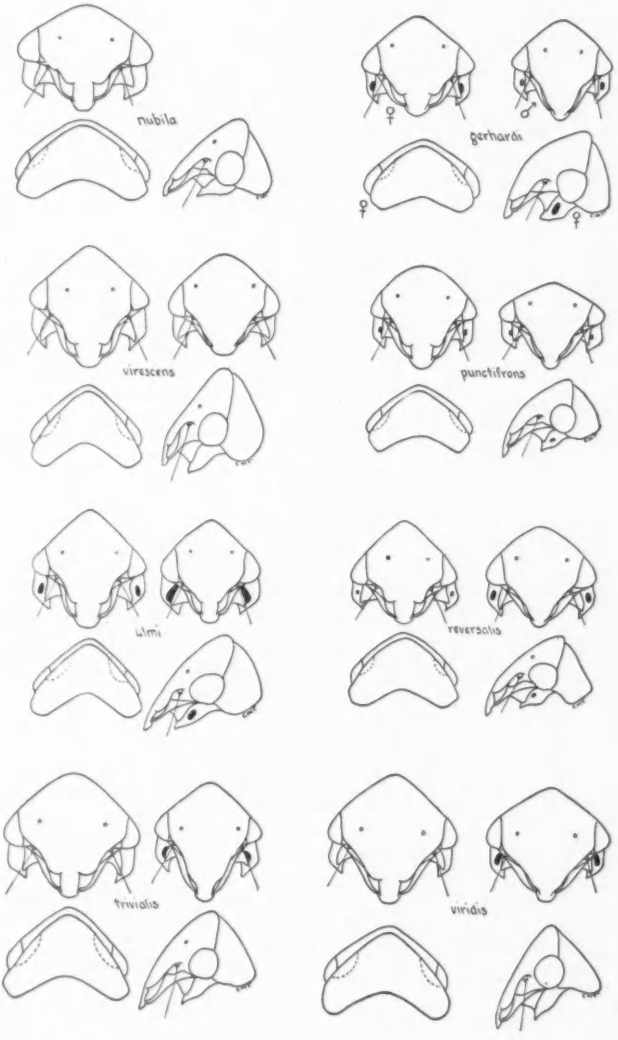
EXPLANATION OF PLATES.

The figures illustrative of each species are grouped about the species name. The group in the upper right hand corner of Plate I is the key to each group on that plate. For example, the figures for *Macropsis gerhardi* on this plate have added to them the signs for the sex of each of the four figures. This is the key to the arrangement for all other figures on the plate.

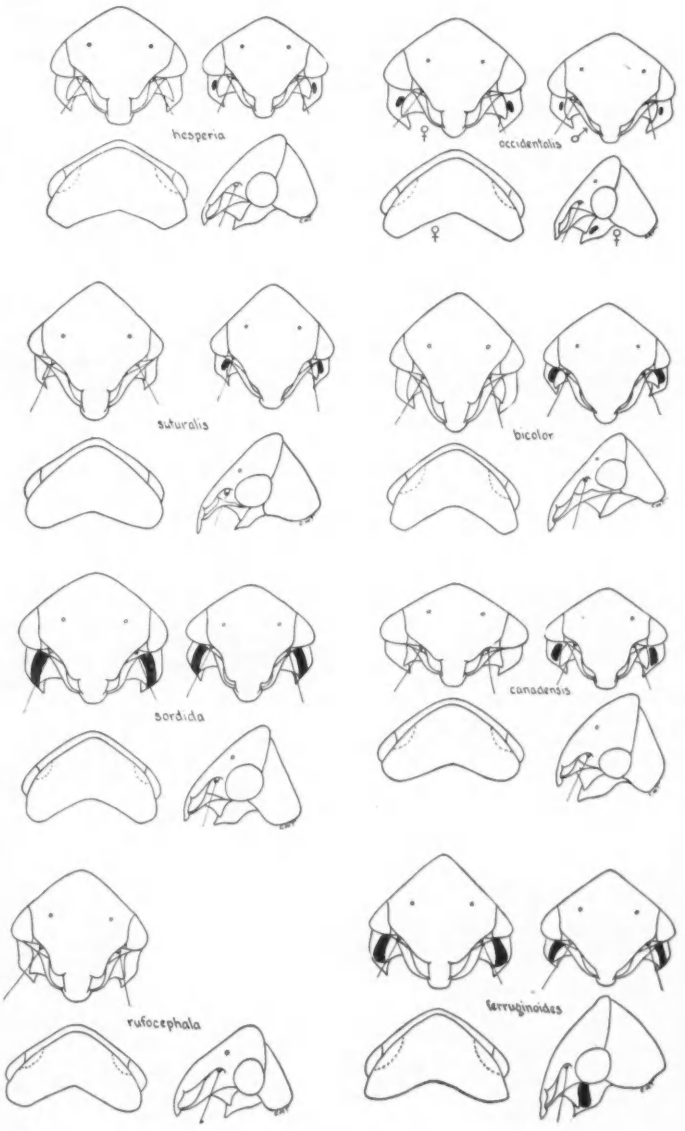
Genus Macropsis, Cicadellidae
Edward Paul Breakey

PLATE I.



Genus Macropsis, Cicadellidae
Edward Paul Breakey

PLATE II.



Genus Macropsis, Cicadellidae
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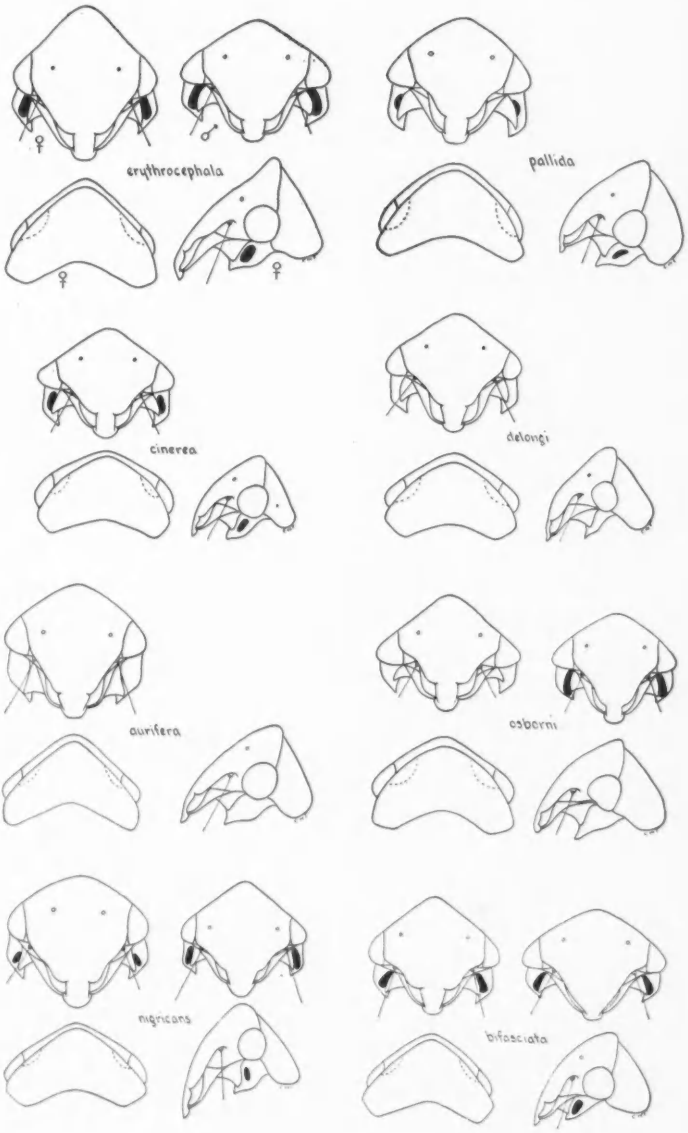
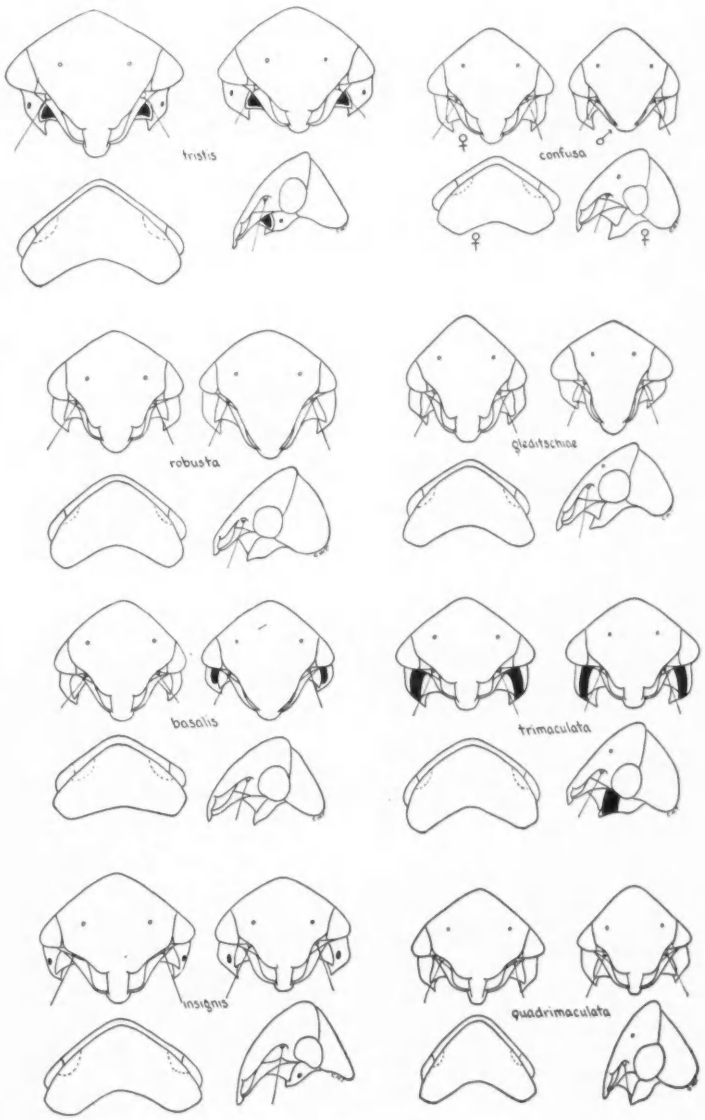
PLATE III.



Genus Macropsis, Cicadellidae
Edward Paul Breakey

PLATE IV.



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September Number—October 3, 1932.
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